New Junior Encyclopedia

Vol 2

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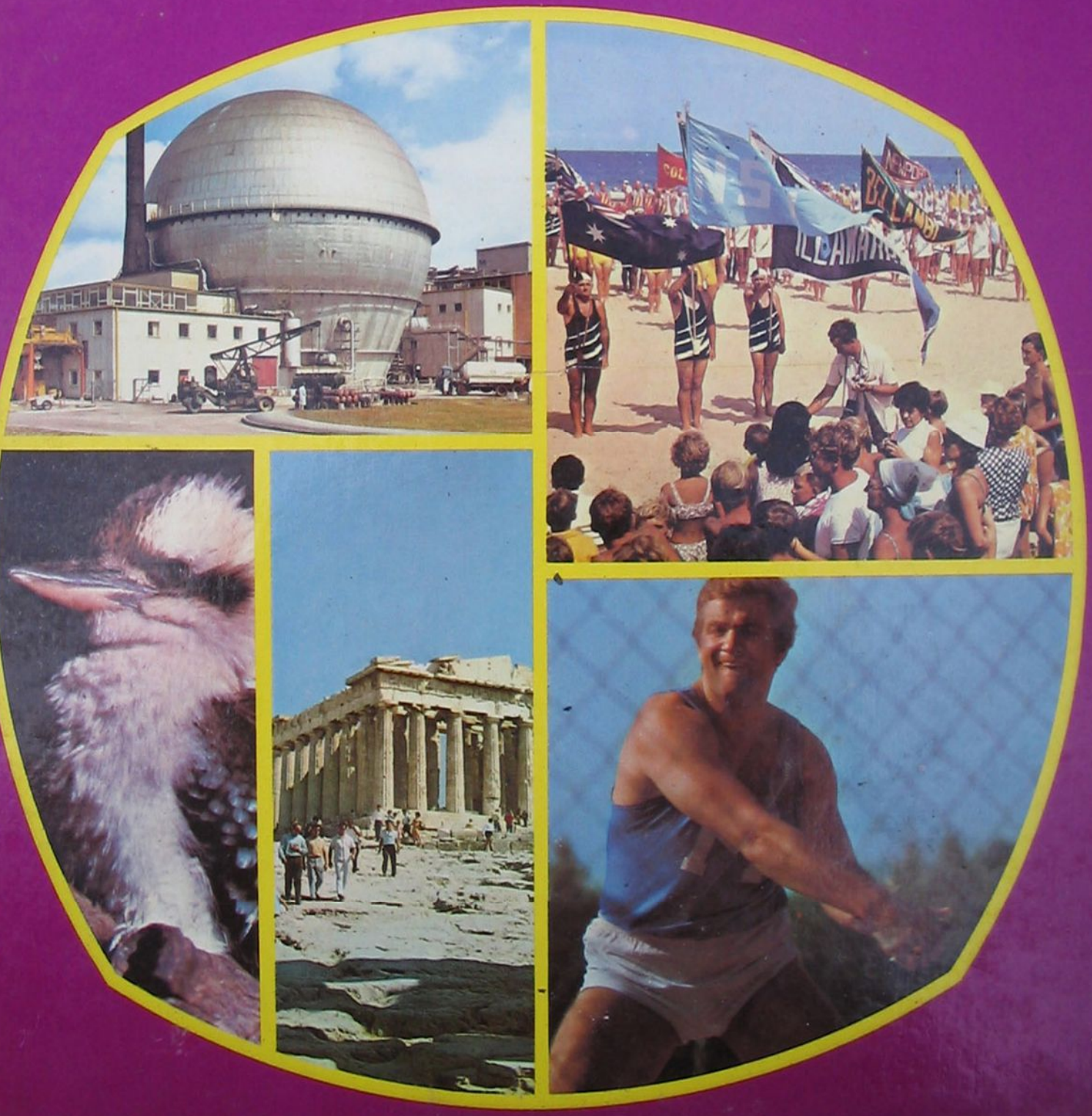

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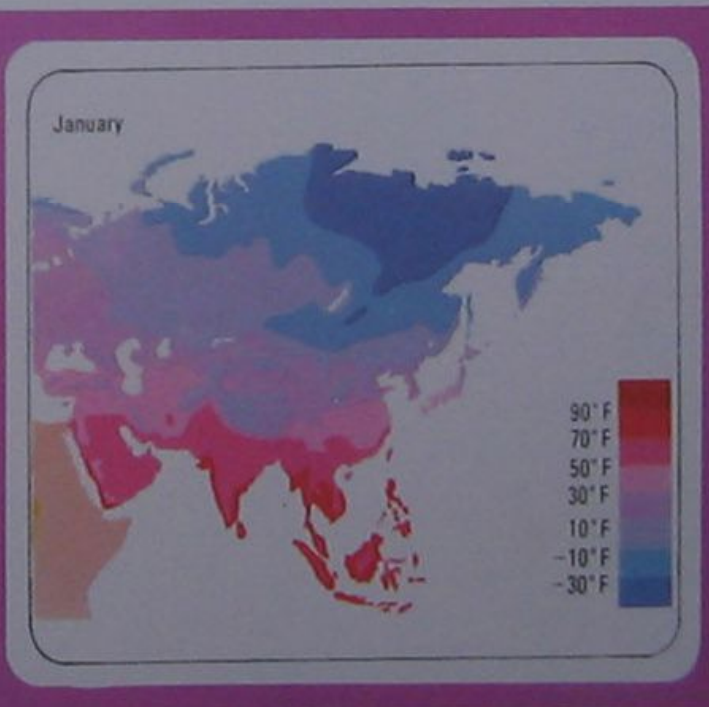
Distributed in U.K. by arrangement with
City Magazines, 1-3 Wine Office Court, Fleet Street, London.
Distributed in Australia and New Zealand by
Bay Books (Pty) Ltd, Sydney.
Made and printed in Great Britain by
Purnell & Sons Ltd, Paulton.



The projector in a planetarium reproduces part of the sky on the inside of a huge dome.
See Astronomy, page 98.

Roman Legionary
1st Century A.D.

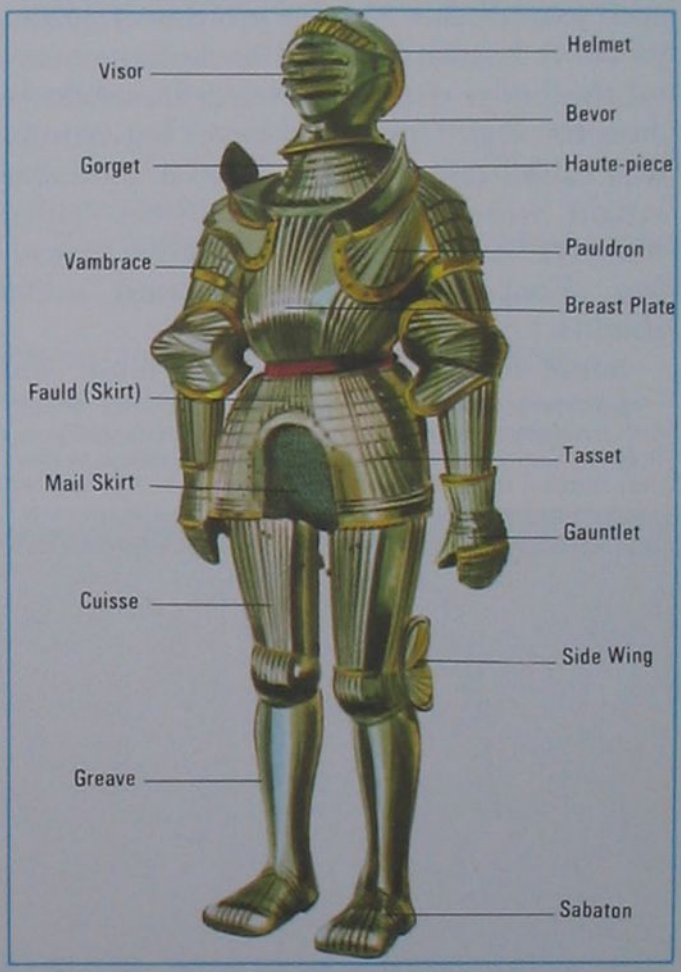
English Knight
Early 14th Century

Austrian Knight
Late 15th Century

Italian Knight
Mid 16th Century

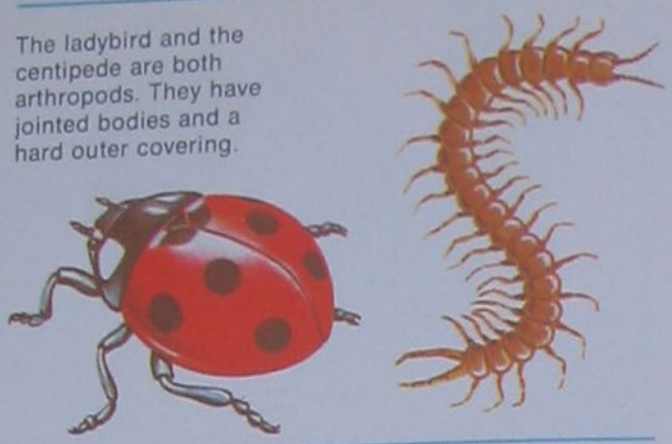
Armour is special clothing that protects the wearer against an enemy's weapons. The earliest armour was made of animal skins and leather. It gave the wearer some protection against arrows, spears and clubs. Then men made metal shields, helmets and breast plates. The rest of the body was still protected by leather or by a kind of fine wire-mesh called chain mail. During the Middle Ages, when knights rode into battle, armour became more elaborate. It covered the arms, legs, hands and feet. There was even armour for horses, and in India men rode on armoured elephants. Arrows and swords could not pierce the metal armour, and so some knights fought with great iron clubs and maces. Armourers covered armour with decorations. Painting, engraving, and even gold and gems glistened on the armour, although the most ornate suits were worn only for show.

As soon as soldiers became armed with muskets and pistols, armour was abandoned because bullet-proof armour could not be made light enough to wear. For hundreds of years, only the helmet continued in use as armour. Then during and after World War II, new materials were developed. Tough metals and plastics were used to make armour. Airmen on bombers wore flak-suits to protect them against flying splinters of metal. Soldiers wore bullet-proof waistcoats made of overlapping plastic or metal plates mounted on cloth like the tiles on a roof. Today some state leaders and policemen wear



body armour to protect them against assassins' bullets. In modern warfare, *armour* is the name given also to an army's tanks and mobile guns.

In the Middle Ages, a full suit of battle armour weighed up to 70 pounds. It consisted of various pieces, some of which had curious names. A helmet completely covered the head, with a hinged *visor* at the front. The visor was normally open and lowered only in battle to protect the wearer's eyes. A collar protected the neck



The ladybird and the centipede are both arthropods. They have jointed bodies and a hard outer covering.

and joined the helmet to the shoulder piece. A breastplate and backplate covered the body, with a *skirt* and *tasset* down onto the legs. Upper and lower leg-armour was called *cuisse* and *greave*. A mounted knight wore pointed steel shoes called *sollerets* and metal gloves called *gauntlets*. Foot soldiers also carried metal shields.

Some of the most ornate armour was made in Japan and other eastern countries. Japanese warriors called *samurai* wore armour for ceremonial occasions until a hundred years ago.

Arthropods belong to the *phylum* (major group) of animals called the *Arthropoda*. The name 'arthropod' comes from Greek words meaning 'jointed foot', but the legs are jointed as well as the feet. They also have bodies made up of jointed sections, with a hard outer covering called an *exoskeleton*. There is no internal skeleton. Arthropods make up about three-quarters of the world's animals. They include insects, crustaceans, spiders, and centipedes and millipedes.

Arthur was a legendary king of Britain during the Dark Ages of the A.D. 600's. The story of King Arthur and his Knights of the Round Table was popular in several western European countries in the early Middle Ages. It inspired some of the greatest literature of the period. In this

Arthur's knights take an oath to search for the Holy Grail, in Christian legend the cup used by Jesus at the Last Supper. It was found by Lancelot's son, Sir Galahad.

literature, Arthur and his knights represent the medieval ideal of knightly *chivalry*—that is, bravery and courtesy.

According to legend, Arthur was the son of Uther Pendragon, king of Britain. He was brought up secretly, and after his father's death, nobody knew who the king should be. Arthur won recognition as king of Britain when he pulled a sword out of a stone where it had been embedded. Merlin, the court magician, then revealed Arthur's true identity.

Reigning in his court at Camelot, Arthur proved himself to be a noble king and a great warrior. He owned a miraculous sword named *Excalibur*, given to him by the mysterious Lady of the Lake. Together with his knights, Arthur held court at the Round Table. He chose a round table so that his knights could not quarrel about who should sit at the head.

Arthur had several enemies. Among them were his half-sister, Morgan le Fay, and Mordred, his nephew. Morgan le Fay was an evil sorceress and schemed to win Arthur's throne for herself and her lover. Mordred seized Arthur's throne while the king was absent. Later, in a battle, Arthur killed him, but was fatally wounded himself. Arthur's body was then carried away to the magical island of Avalon. His people thought that one day he would return to rule over them again.

Two of Arthur's greatest knights were Sir Tristram and Sir Lancelot. Both of them were involved in tragic love affairs. Tristram fell in love with Isolde, who was betrothed to his uncle, King Mark. Sir Lancelot fell in love with Arthur's queen, Guinevere.

The legends about King Arthur are believed to have originated among the Celtic peoples of Wales and Ireland. By the 1100's, the legends had developed into a varied literature. One of the greatest medieval works about Arthur was Sir Thomas Malory's *Morte d'Arthur* (Death of Arthur) written in the 1400's.

In the 19th century the legends of Arthur and his knights again became fashionable. In 1858 William Morris published his poem Defence of Guenevere, *and the tales provided the Pre-Raphaelite painters with subjects. Most famous of all were Lord Tennyson's* Idylls of the King, *a series of connected poems published between 1842 and 1885. Today the best known of these poems is* The Passing of Arthur, *particularly the passage where the dying king says:*

The old order changeth, yielding place to new,
And God fulfils himself in many ways,
Lest one good custom should corrupt the world.

Asbestos The special protective suits that some firemen wear when fighting a fierce fire, such as an oil fire, do not catch fire because they are made of rock. A certain group of minerals is found naturally in the form of tiny fibres. They are all given the name of *asbestos*.

The longest of these fibres can be spun

Below: Raw amosite asbestos from South Africa.

Below: Clutch plates. Asbestos, with its heat resisting properties, is an important part of clutch facings and brake linings.

Population map of Asia. Each dot represents approximately 100,000 people.

and woven into a fireproof cloth. Short-fibred asbestos is made into automobile brake and clutch linings, which have to withstand heat. Mixed with cement, it makes an excellent roofing material. With a suitable binder, it is used to insulate boilers and furnaces. Asbestos is a good electrical insulator, too, and is resistant to acids and alkalis.

By far the most important variety of asbestos is *crysotile,* or *white asbestos.* Asbestos rock may be mined on the surface or underground. The rock is sorted roughly by hand before passing through various crushing and screening (filtering) units, where first the long then the short fibres are extracted.

Asia is the largest of the continents and has more people than any other continent. It covers about 17,153,000 square miles—almost one-third of the land area of the world. Its greatest distance, east to west, is 6,000 miles, and north to south about 5,400 miles. Its population is about 1,887,500,000. This means that 57 out of every 100 people live in Asia.

Asia is a continent of extremes. It has the highest mountains and the lowest depths. Parts of the continent are colder than the North Pole but other areas are among the hottest places on Earth. More rain falls in parts of southern Asia than anywhere else in the world, but some Asian deserts are among the driest places on Earth.

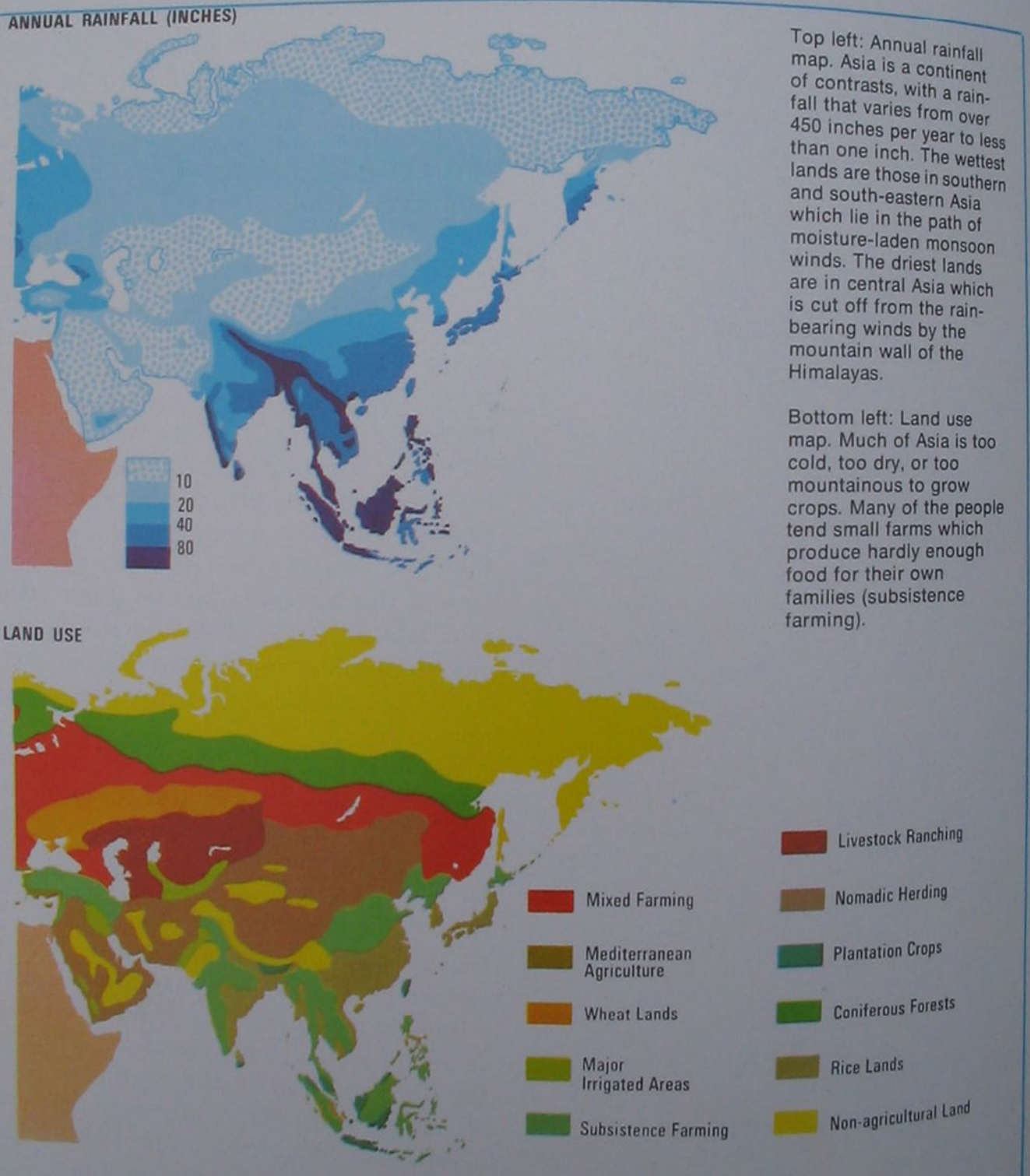
Asia extends from the Ural Mountains in the west to the Pacific Ocean in the east: and from the Arctic Ocean in the north to the Indian Ocean in the south. Its south-western frontier with Europe runs along the shores of the Caspian Sea, Black Sea and Mediterranean. Asia is joined to Africa by the isthmus of Suez, which is cut in two by the Suez Canal. It is separated from North America by the Bering Strait in the north-east, only 45 miles wide at its narrowest part.

Asia can be conveniently divided into six major regions. *Central* or *Inner Asia*

is a triangular mass of mountains and high, remote plateaus. It includes Tibet, Mongolia and parts of western China. Many ranges of mountains meet in the *Pamir Knot*, sometimes called the *Roof of the World*. The Himalaya range includes Mt Everest (29,028 ft), the world's highest peak.

Northern Asia includes the vast Russian lowlands of Siberia. The region stretches from the Ural Mountains in the west to the Pacific Ocean in the east. It is drained by a number of huge rivers. *Eastern Asia*, or the *Far East*, is a mountainous area that includes most of China, Japan, Korea, and Formosa. This is where nearly half the Asian people live.

Southern Asia is the region that lies to the south of the Himalaya mountains. It includes the ancient plateaus of Afghanistan, Bhutan, India and Pakistan. *South-western Asia* is a dry region that includes Turkey, Iran and the Arabian Peninsula. *South-eastern Asia* includes the land



Top left: Annual rainfall map. Asia is a continent of contrasts, with a rainfall that varies from over 450 inches per year to less than one inch. The wettest lands are those in southern and south-eastern Asia which lie in the path of moisture-laden monsoon winds. The driest lands are in central Asia which is cut off from the rain-bearing winds by the mountain wall of the Himalayas.

Bottom left: Land use map. Much of Asia is too cold, too dry, or too mountainous to grow crops. Many of the people tend small farms which produce hardly enough food for their own families (subsistence farming).

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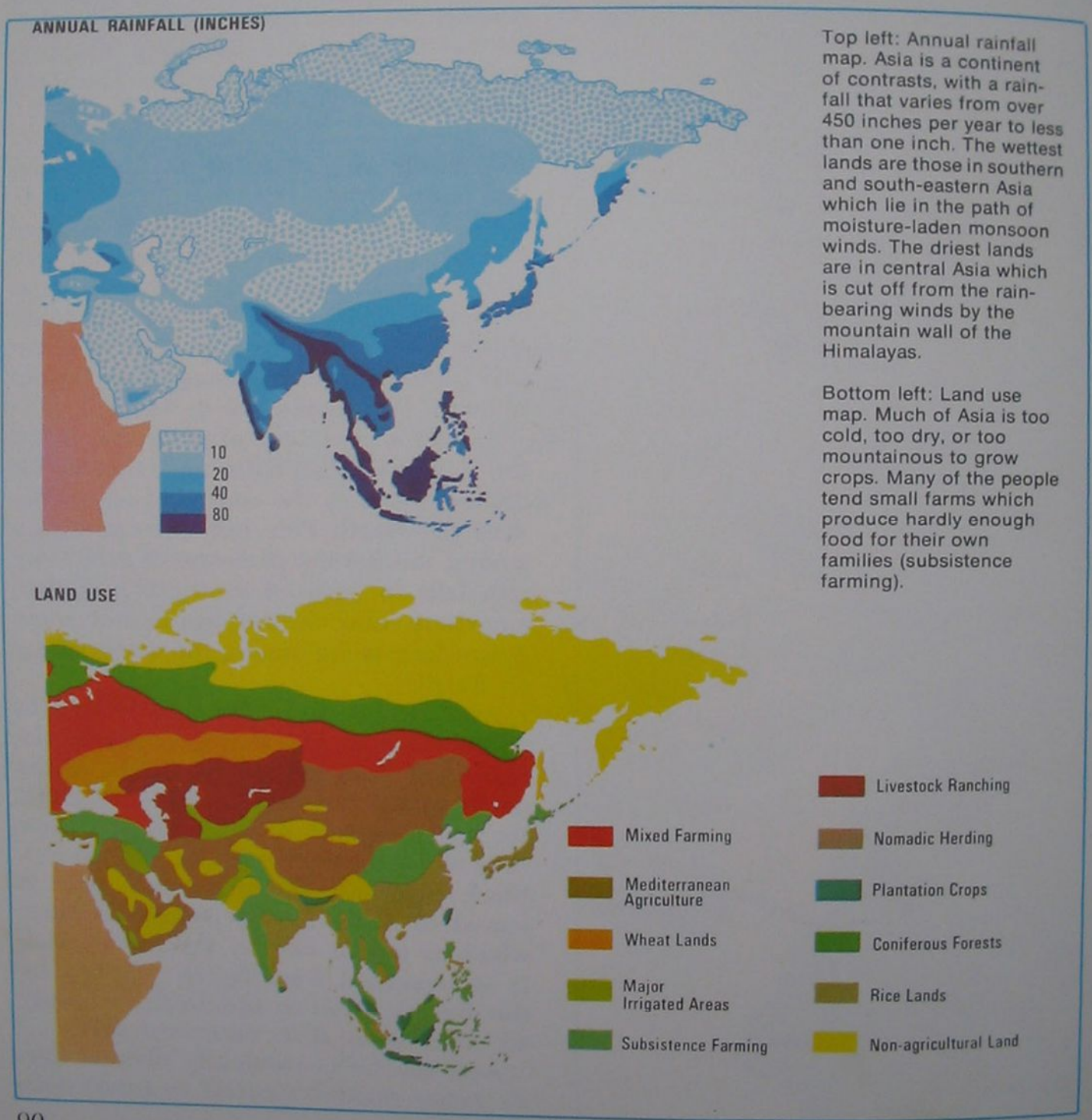

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INDEPENDENT COUNTRIES OF ASIA

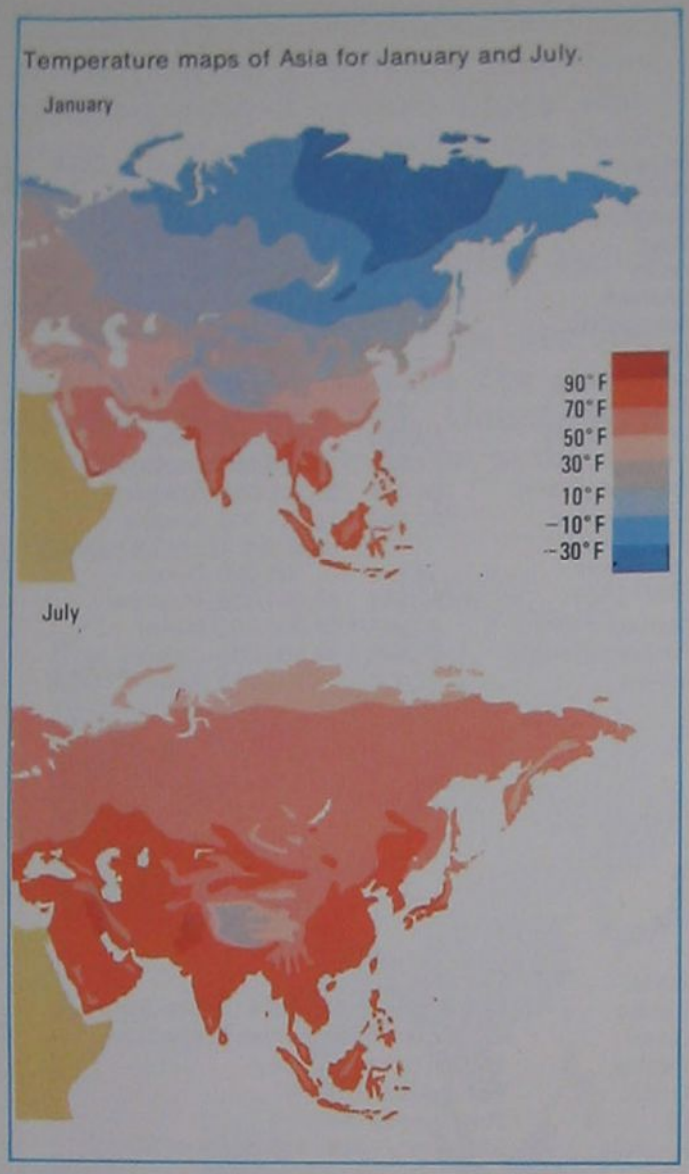
Country	Area (sq. mi.)	Population	Capital
Afghanistan	253,861	17,000,000	Kabul
Bangla Desh	55,126	72,500,000	Dacca
Bahrein	231	207,000	Manama
Cambodia	69,898	7,100,000	Phnom Penh
Ceylon (Sri Lanka)	25,332	12,730,000	Colombo
China	3,691,502	759,600,000	Peking
Cyprus	3,572	636,000	Nicosia
Formosa (Taiwan) (Nationalist China)	13,885	14,753,900	Taipei
India	1,262,274	547,000,000	New Delhi
Indonesia	735,269	120,000,000	Djakarta
Iran (Persia)	636,294	28,662,000	Tehran
Iraq	173,260	9,400,000	Baghdad
Israel	7,992	2,900,000	Jerusalem
Japan	142,726	103,700,000	Tokyo
Jordan	37,301	2,300,000	Amman
Korea, North	46,540	13,300,000	Pyongyang
Korea, South	38,004	32,100,000	Seoul
Kuwait	6,000	733,196	Kuwait
Laos	91,429	3,000,000	Vientiane
Lebanon	4,015	2,800,000	Beirut
Malaysia	128,654	10,800,000	Kuala Lumpur
Maldive Islands	115	108,000	Malé
Mongolia	592,665	1,300,000	Ulan Bator
Nepal	54,362	11,247,616	Katmandu
Oman	82,000	600,000	Muscat
Pakistan	310,403	64,400,000	Islamabad
Philippines	115,707	38,000,000	Quezon City
Qatar	4,000	100,000	Doha
Saudi Arabia	870,000	7,700,000	Riyadh
Singapore	224	2,075,000	Singapore
South Yemen	60,000	1,300,000	Aden
Syria	71,228	6,294,000	Damascus
Thailand (Siam)	194,456	39,202,000	Bangkok
Turkey (Asia)	292,260	32,501,000	Ankara
United Arab Emirates	32,278	185,000	Dubai
USSR (Asia)	8,252,000	58,964,000	Moscow
Vietnam (North)	61,294	21,200,000	Hanoi
Vietnam (South)	69,948	18,000,000	Saigon
Yemen	75,290	5,700,000	Sana

COLONIES AND TERRITORIES IN ASIA

Name	Area (sq. mi.)	Population	Capital	Status
Bhutan	18,147	800,000	Thimbu	Monarchy under Indian Protection
Brunei	2,226	116,000	Brunei	Sultanate under British Protection
Hong Kong	398	4,089,000	Victoria	British Crown Colony
Macao	6	161,000	Macao	Portuguese Colony
Portuguese Timor	7,383	590,000	Dili	Portuguese Colony
Sikkim	2,744	194,000	Gangtok	Monarchy under Indian Protection

Fishing is important in the coastal regions of Asia, since farmland is often so valuable for growing crops that it cannot be used for rearing animals to eat.

One of Bangkok's Buddhist temples. It is typical of many throughout Asia. Buddhism, like all the world's great religions, was born in Asia.



south of China and east of India, and the Indonesian, Malaysian and Philippine islands.

There are some large bodies of inland water in Asia. The Caspian Sea, the world's largest inland sea, lies between Asia and Europe. The shore of the Dead Sea, partly in Israel and partly in Jordan, lies about 1,300 feet below sea level.

Among many huge rivers in Asia the Lena, Yenisei, and Ob are frozen for part of their courses during six months of each year. In the spring, when the rivers are full, and their mouths are still ice-bound, great floods occur. Other important rivers are the Jordan, that flows southwards from Lebanon to the Dead Sea; the Tigris and Euphrates, which drain Iraq; the Brahmaputra and the Ganges that empty into the Bay of Bengal through a common delta; and the Indus, which rises in western Tibet and flows into the Arabian Sea.

In China the chief rivers are the Hwang, the Si-Kiang, and the Yangtze. The plain of Manchuria is drained by the Amur and its tributary, the Sungari. The mountains in or near Tibet give rise to several major rivers, among them the Brahmaputra, Hwang, Indus, Mekong, Salween and Yangtze.

Deserts are plentiful throughout Asia. Most of the Arabian Peninsula is desert, and the Gobi desert occupies an enormous plateau in central Asia.

The far north of Asia has an arctic climate, and the southern regions are equatorial. The interior of the continent suffers great extremes of climate. Winters are bitterly cold but summers produce a fierce heat. These extremes cause great differences in pressure and wind systems and are the cause of the violent *monsoons* (seasonal winds) that bring heavy rain to all of south-east Asia from May to October.

Asian wild animals include tigers, monkeys, rhinoceroses, bears, deer, mongooses, and many kinds of poisonous and non-poisonous snakes. Some wild animals, such as the elephant and the water buffalo, have been tamed and trained to work in the forests and fields.

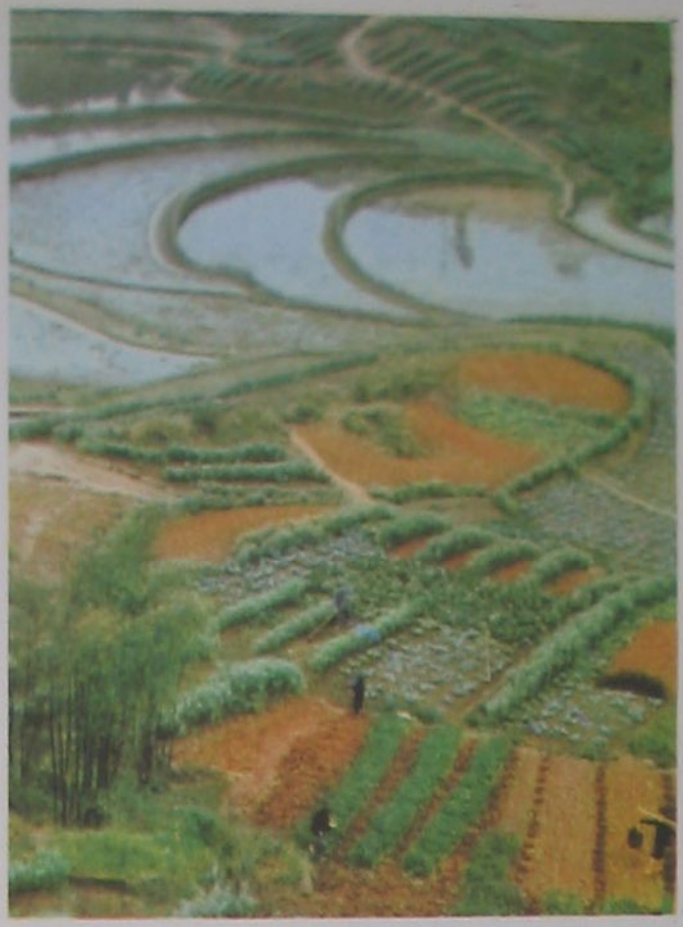
Vegetation varies with the climate. Northern Asia contains the world's largest fir and pine forest. Temperate grasslands and desert scrub cover some other parts of the continent.

Most people in Asia eat rice as their main food. Rice grows in the wet, tropical regions. In drier areas other cereals such as maize, wheat, millet and soya beans are grown. Timber is a valuable product. The tropical regions yield quantities of teak, pine wood comes from Siberia, and hardwoods from the forests of China. Other important agricultural products are tea, tobacco, rubber, dates, jute, cotton and olives.

Much Asian industry consists of handicrafts produced in small factories and

workshops. The great exception is Japan. Japan leads the world in shipbuilding and is also a leading steel producer. Northern China, parts of India, and central Siberia also have modern, well-equipped factories that produce a wide range of goods. But most Asian nations export few manufactured goods because they are unable to meet the needs of their own people. Many exports are minerals. A quarter of the world's petroleum comes from south-eastern and south-western Asia. Turkey and the Philippines export chromite, and nearly two-thirds of the world's tin comes from south-eastern Asia.

Most of the world's earliest civilizations and all the world's great religions began in Asia. More than 2,000 years ago powerful empires flourished in the continent. Their peoples reached a high development in the arts and sciences. They began to influence Europe, especially through contact with the ancient Greeks, from about 300 B.C. But because the various Asian peoples were separated from each



Above: More than half of the world's population lives in Asia, but much of the land is too mountainous, too cold, or too dry to grow crops. As a result, farmland is precious and in many places great care is taken with tiny patches of ground to obtain the largest yields possible. Rice is the main crop in much of Asia and whole hillsides are sometimes terraced to provide the flooded paddyfields this crop needs in order to grow.

Left: Hong Kong, a minute British colony off the coast of China, is one of the greatest trading centres in Asia.

Archduke Ferdinand of Austria-Hungary just before his assassination at Sarajevo on June 28, 1914. This was one of the immediate causes of World War I.

other by vast deserts and lofty mountain ranges, they never became as closely knit as some of their western neighbours. They gradually developed different languages, customs and ways of life.

After World War II the political map of Asia was profoundly altered. Many nations once subject to colonial rule achieved their independence.

Talking points

* Several of the world's oldest civilizations began in Asia. Find out why this was so, and describe one of them in detail.
* How has Communist rule changed the traditional life in China, and capitalism the life of Japan?
* Make a scrap book illustrating the customs and dress of the main countries of Asia. Try to get pictures of local markets, etc.

Articles to read

See under countries and cities of Asia. Also: Angkor; Buddha; Confucius; Dyaks; Gandhi; Hinduism; Indus Valley Civilization; Mao Tse-tung; Nehru; Sun Yat-sen; Sukarno; Taj Mahal.

Assassination During the late 1000's a Persian called Hasan founded a Muslim religious Order. Its members were mystics and took drugs, and they murdered their enemies. The Order was tightly disciplined. In 1090 Hasan made his headquarters in Khorassan in a castle called Alamut, which meant the Eagle's Nest. Hasan and his successors were called Sheikh-el-Jebel, the 'Old Man of the Mountains' to Europeans. Hasan's followers were called Hashshashin, hashish-eaters, which became Assassins in English. Assassination means murdering for religious or political reasons.

The Assassins had an active headquarters in Syria and many secret branches. They were opposed to the religious views of most rulers of the Muslim world. For 150 years the Assassins terrorized the Middle East with religious and political murders. Even Saladin was unable to destroy them. Only in 1255 was their power ended.

Assassinations have been committed in almost every country. In the 1960's the world was shocked by the assassinations in the United States of President John F. Kennedy (1963), his brother Robert (1968), and the Civil Rights leader Martin Luther King (1968).

Assyrian winged figure.

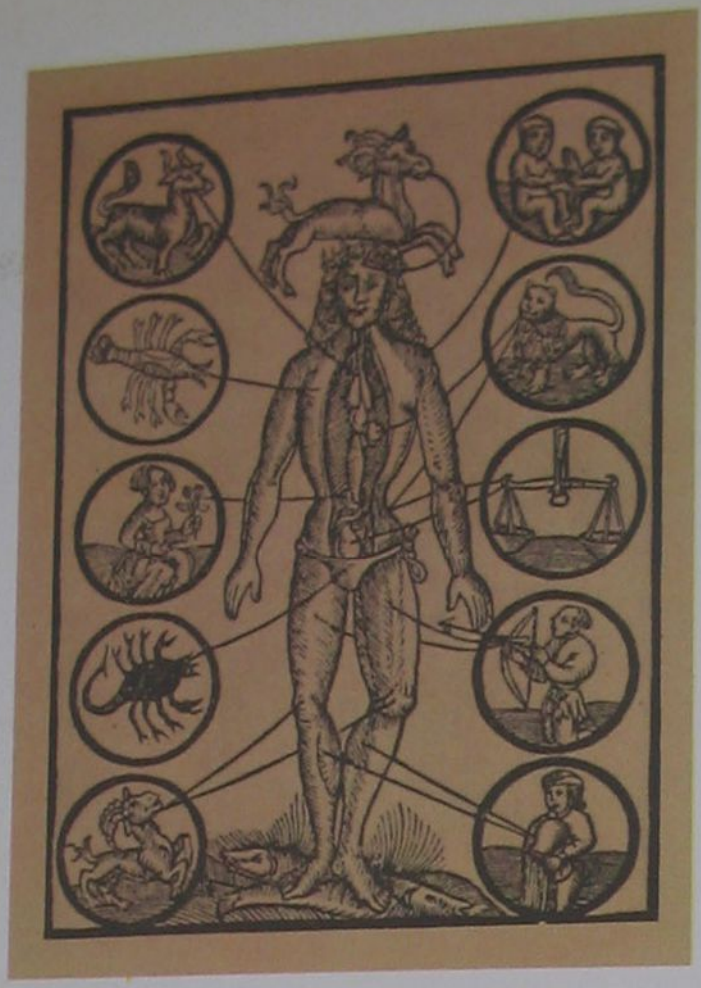
Assyrians The Assyrians were a Semitic people living in the north of Mesopotamia. Their chief city was Assur. They were merchants and soldiers. First they threw off Sumerian rule (see Sumer) and then between 1726-1694 B.C., they conquered neighbouring tribes and built up an empire. But it was short lived. Assyria became a subject state of Babylonia (see Babylonia) after 1679 B.C. and did not begin to expand again for many centuries.

Under Tiglath-Pileser I, the Assyrians began to conquer other tribes again and in 1097 B.C. they sacked Babylon. Tiglath-Pileser's successors, in spite of many revolts by the people they conquered, pushed the frontiers of the Assyrian empire as far as Egypt. In 673 B.C. King Esarhaddon launched a successful attack on Egypt and brought it under his control. During the reign of his son Ashurbanipal (669-626 B.C.) Assyria's empire reached its greatest extent. Then, it collapsed even more swiftly than it had risen. The Babylonians first broke away from Assyrian rule in 626 B.C. and in 612 B.C., in alliance with the Chaldeans, they captured Nineveh. In 610 B.C. an Egyptian army arrived too late to save Harran, the last Assyrian city to be subdued.

The Assyrian empire was above all a military one. It was a nation of warriors and the king's main task was to lead the army. The officers were Assyrians, but the ordinary soldiers were mercenaries (men who were paid to fight) drawn from the various tribes within the empire. They fought in war chariots and on foot and they had skilled engineers to conduct sieges. The ruins of the splendid temples and palaces which the Kings of Assyria built are covered with sculptures and bas reliefs (raised pictures cut in stone) showing incidents from their battles. Ashurbanipal's library has also been preserved, so providing written records of the empire.

Asteroids are small planets whose paths around the Sun lie mainly between those of Mars and Jupiter. About 2,000 of them have been found. Only one, Vesta, can be seen with the naked eye, and even then only on the clearest nights. The largest asteroid, Ceres, is only 480 miles across. Some astronomers believe that the asteroids may be the remains of a planet which broke up long ago.

Ceres, the largest asteroid, compared in size with the British Isles.



Left: Astrologers believed that the signs of the zodiac ruled various parts of the body.

Astrology Many newspapers and magazines contain columns called something like "What the Stars Foretell" written by *astrologers*. Astrology is the study of the Sun, Moon, planets, and stars to find out how they influence people and their affairs. It is quite different from *astronomy*. Astronomers do not believe that astrology is a science at all. They cannot see how lumps of matter, millions of miles away in space, can possibly affect the lives of men and women.

The astrologer *casts a horoscope* for a person. He draws a diagram showing the position of the heavenly bodies and the 12 signs of the zodiac at the time of the person's birth. From this he claims to be able to describe that person's character and foretell the main events of his future.

For thousands of years astrologers were among the most important people in the courts of kings. They used the stars to interpret dreams and unusual events and to foretell the future. Their early studies paved the way for modern astronomy.

Astronautics is the branch of science which deals with the many problems of space flight.

The Space Age began with the launching of the artificial satellite Sputnik 1 on October 4, 1957. Less than four years later, on April 12, 1961, came the first manned flight. The Russian Yuri Gagarin made one orbit of the Earth in his spacecraft Vostok 1. He was the first space-pilot, or *astronaut*. (The Russian term is *cosmonaut*.) After years of preparation, the United States landed a manned spacecraft, Apollo 11, on the Moon on July 20, 1969. In the next few years several more successful Moon landings were achieved by the United States, and valuable scientific experiments were carried out. Later astronauts were helped in these by the small vehicle, or 'Moon buggy', they took with them.

A spacecraft is carried into space on top of a massive rocket, which lifts it clear of the Earth's atmosphere and gives it the very high speed required to keep it in orbit or propel it to the Moon.

A spacecraft can stay in orbit if it has enough speed to overcome the 'pull' of the Earth, or *gravity*. For an orbit 100 miles above the Earth, this *orbital velocity* is about 17,500 miles an hour. At this distance and orbital velocity the tendency of the spacecraft to fly away from the Earth (like a stone from a sling) is balanced by the pull of gravity.

There is, then, no effective gravity in orbit. Everything is therefore weightless. This state is often called zero G, G standing for gravity.

The spacecraft must be lifted above the Earth's atmosphere to avoid the resistance, or *drag*, of the air. Drag would quickly slow it down and make it fall back to Earth. Also friction with the air would heat the craft and might even make it burn up, just like a meteor does.

Launching an astronaut into space and

Above: The problem of the tremendous thrust required for a space-launch was solved by building multi-stage rockets. When the first stage burns out it falls away, leaving the progressively smaller second and third stages less weight to propel upwards.

Top right: Man 'walks' in space. Travelling at the same speed as the spacecraft to which he is attached, the astronaut is weightless.

Middle right: American astronauts land in the sea. The space capsule floats, but frogmen attach a buoyant collar around it as a precaution.

Bottom right: An astronaut's full space-rig is airtight. On the ground a portable air-conditioner is attached to it.

bringing him back is a very hazardous business. To start with, he has to withstand the great forces of acceleration during take-off. Then he must adjust to the effects of weightlessness in orbit. He must be protected by his spacecraft or a space-suit from the cold and airless world of space. Finally, on his return from space, he must survive the rapid slowing down and heating effects caused by the drag of the atmosphere.

Astronauts receive special training to prepare themselves for space flights. For example, they spend a long time in a machine called a centrifuge, which whirls them round and round rapidly and reproduces the kind of forces they can expect during take-off and landing.

The astronauts also train in dummy spacecraft which can be made to do many of the things a real one does in space.

After months of intensive training, the astronauts climb into their spacecraft and are rocketed into space. They lie on their backs during launching because this is the best way to withstand the great 'push' of the rocket.

Up in space the astronauts, like everything else, are weightless. Nothing keeps them 'down', and they can float around freely. Eating and drinking are very different from on Earth. Food and drink must be squeezed right into the mouth.

The crew cabin of the spacecraft is connected to what is known as a *life-support system*. This provides gas under pressure for the astronauts to breathe, removes stale air and moisture, and keeps the temperature steady.

Returning to Earth is probably the most dangerous part of the space flight. To fall down from orbit, the spacecraft must be slowed down to below orbital velocity. This is done by firing rockets called *retro-rockets* in the direction in which the spacecraft is travelling.

After the retro-rockets have fired, the capsule containing the astronauts separates from the rest of the craft. It drops rapidly towards the Earth and re-enters the atmosphere. The atmosphere acts like a brake and quickly slows down the capsule and heats it at the same time. The base of the capsule glows red-hot, but it is specially designed as a *heat shield* to protect the astronauts inside. As the capsule falls lower, parachutes open and gently lower it to the ground or the sea.

Astronomy is the scientific study of the stars, planets, and other heavenly bodies. For many thousands of years men have watched the skies and tried to explain what they have seen there. The movements of the Sun, the Moon, and some stars were used by early Man as a calendar to guide him in planting and reaping his crops.

The astronomer, like any other scientist, needs a laboratory and instruments. His 'laboratory' is called an *observatory*. His most important instrument is the *telescope*. Most observatories are equipped with various kinds of telescopes.

Powerful telescopes are required because the astronomer is studying objects so far away that their distances are measured not in miles but in *light-years*. One light-year is the distance travelled by a ray of light in one year; it is nearly six million million (6,000,000,000,000) miles.

Some people study the stars and planets as a hobby. Many important discoveries have been made by amateur astronomers using small telescopes.

Ataturk, Kemal (1881-1938), Turkish soldier and statesman who founded the Republic of Turkey and became its first president. Ataturk introduced reforms that greatly changed the way of life of people in Turkey. Islam ceased to be the state religion, women were given votes, and traditional customs of various kinds were abolished. The educational system was westernized, the Roman alphabet adopted, new systems of finance introduced, and new industries created.

Photo: Sonia Halliday

A model of Kemal Ataturk, and the photograph from which it was taken, in the Military Museum in Ankara, Turkey. Ataturk's reforms brought modern, western ways to the Turks who until then had been leading an almost medieval and decidedly Eastern life.

Ataturk was born in Salonica, and became a soldier. He organized the defence of the Dardanelles against the Allies in World War I, and later led a Turkish revolutionary government in opposition to that of the Sultan. He refused to accept Allied peace terms, expelled the Greeks from territory he considered Turkish, and eventually abolished the sultanate and obtained Allied recognition. Until 1934, when he adopted the name Ataturk, he was known as Mustafa Kemal. The name *Ataturk* appropriately means *father of the Turks*.

Athabasca, Lake This lake in midwestern Canada covers an area of about 3,100 square miles. Two thirds of Lake Athabasca lies in the province of Saskatchewan. The rest lies in Alberta. The Athabasca and Peace rivers flow into the south-western tip of the lake. It is drained by Slave River in the north-west. Rich deposits of uranium are found around the lake, which lies in an important mining region.

Athens is the capital and largest city of Greece. It is the seat of the Greek government and the commercial centre of the Attica region. For centuries it has been a centre of Greek learning and art.

The city is situated on the plain of Attica close to the southern tip of the Greek mainland. Piraeus, the city's seaport, is six miles from the centre on the Apollo coast of the Saronic Gulf. The ancient city first clustered around the Acropolis rock, but modern development has spread far out to the slopes of the surrounding mountains. The total urban population now numbers over 1,850,000.

The ruined temples and statues of the

The 'Golden Age' of Athens was in the 5th century B.C. under the rule of Pericles. At this time the Parthenon was built, and Athens became a centre for leading artists, writers and philosophers.

Acropolis, topped by the Parthenon, and many little Byzantine churches, provide strange contrast with the Royal Palace, university, and modern office buildings. By virtue of its history and monuments, the city attracts thousands of visitors.

Right: The Agora or market place of ancient Athens, at the foot of the Acropolis. On the left is a reconstruction of the Stoa of Attalus.

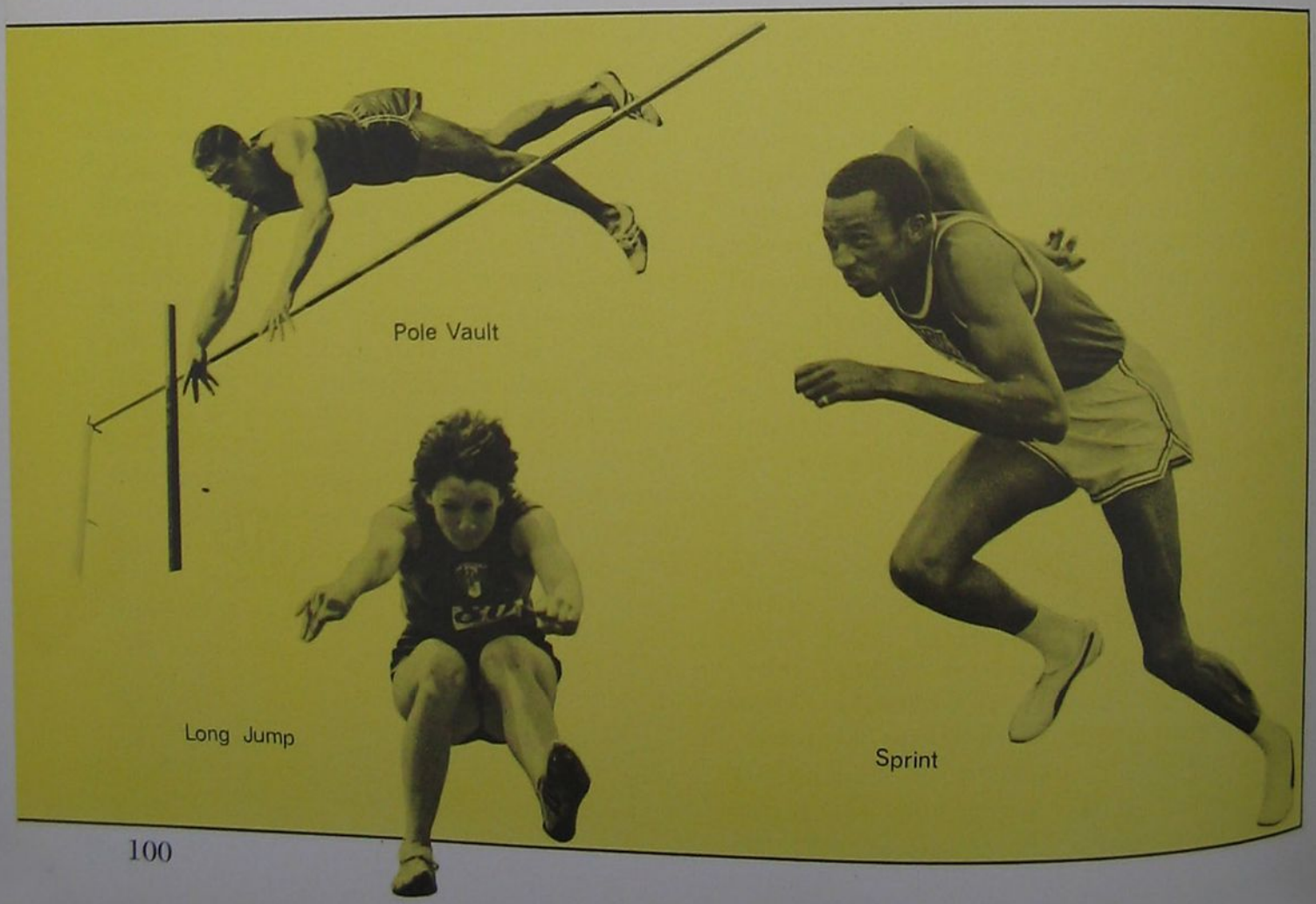
Athletics Track and Field Athletics originated in Greece about the 9th century B.C. with the running, jumping and throwing events of the Ancient Olympic Games. These events were revived in the English universities in the mid-19th century. The Amateur Athletic Association was formed in 1880. The revival of the Olympic Games in 1896 awakened world-wide interest in the sport.

Track events are running races on the flat, or over obstacles, over recognised distances from 100 yards to 6 miles or more. World records are measured in both yards and metres (100 metres = 109 yards 1 foot, 1 inch). Field events normally include the high jump, pole vault, long jump, triple jump, shot putt, and the discus, hammer and javelin throws.

Races up to and including 400 metres (or 440 yards) are run in lanes to allow a separate course for each competitor. Starting blocks are permitted for sprint races. Races start with warning commands, then a pistol shot. A competitor may be disqualified for deliberately impeding another's progress.

The finish is a line drawn across the track at right angles to the inner edge, and a runner is placed according to when his chest reaches the line. The tape is merely a guide for the judges.

High jumpers and pole vaulters attempt to clear a cross-bar set at a starting height decided by the judges or laid down by the organizers. Three consecutive failures mean disqualification. For each succeeding round the height of the bar is raised.



MUNICH OLYMPIC GAMES, 1972 — GOLD MEDALLISTS – ATHLETICS

	Name	Country	Time or Distance
MEN			
100 metres	V. Borzov	U.S.S.R.	10.14 secs
200 metres	V. Borzov	U.S.S.R.	20 secs
400 metres	V. Matthews	U.S.A.	44.66 secs
800 metres	D. Wottle	U.S.A.	1 min 45.9 secs
1,500 metres	P. Vassala	Finland	3 mins 36.3 secs
5,000 metres	L. Viren	Finland	13 mins 26.4 secs
10,000 metres	L. Viren	Finland	27 mins 38.4 secs
Marathon	F. Shorter	U.S.A.	2 hrs 12 mins 19.8 secs
4 × 100 metres relay	—	U.S.A.	38.19 secs
4 × 400 metres relay	—	Kenya	2 mins 59.8 secs
110 metres hurdles	R. Milburn	U.S.A.	13.24 secs
400 metres hurdles	J. Akii-Bua	Uganda	47.82 secs
3,000 metres steeplechase	K. Keino	Kenya	8 mins 23.6 secs
20 kilometres walk	P. Frenkel	E. Germany	1 hr 26 mins 42.4 secs
50 kilometres walk	B. Kannenberg	W. Germany	3 hrs 56 mins 11.6 secs
High jump	Y. Tarmak	U.S.S.R.	7 ft 3¼ ins
Pole vault	W. Nordwig	E. Germany	18 ft ½ in.
Long jump	R. Williams	U.S.A.	24 ft ½ in.
Triple jump	V. Saneyev	U.S.S.R.	56 ft 11 ins
Shot	W. Komar	Poland	69 ft 6 ins
Discus	L. Danek	Czechoslovakia	211 ft 3½ ins
Hammer	A. Bondarchuk	U.S.S.R.	247 ft 8½ ins
Javelin	K. Wolfermann	W. Germany	296 ft 10 ins
Decathlon	N. Avilov	U.S.S.R.	8,454 points
WOMEN			
100 metres	R. Stecher	E. Germany	11.07 secs
200 metres	R. Stecher	E. Germany	22.40 secs
400 metres	M. Zehrt	E. Germany	51.08 secs
800 metres	H. Falck	W. Germany	1 min 58.6 secs
1,500 metres	L. Bragina	U.S.S.R.	4 mins 1.4 secs
4 × 100 metres relay	—	W. Germany	42.81 secs
4 × 400 metres relay	—	E. Germany	3 mins 23 secs
100 metres hurdles	A. Ehrhardt	E. Germany	12.59 secs
High jump	U. Meyfarth	W. Germany	6 ft 3½ ins
Long jump	H. Rosendahl	W. Germany	22 ft 3 ins
Shot	N. Chizhova	U.S.S.R.	69 ft
Discus	F. Melnik	U.S.S.R.	218 ft 7 ins
Javelin	R. Fuchs	E. Germany	209 ft 7 ins
Pentathlon	M. Peters	Great Britain	4,801 pts World Record

The long jumper is allowed an unlimited run-up, but must take-off from a white wooden take-off board, 4 feet long, into a landing area. Each jump is measured from a scratch line made at the end of the board to the nearest break made in the sand of the landing area.

The Marathon is a road race of exactly 26 miles 385 yards and usually commences and finishes at a stadium. The Decathlon comprises ten events in the following order: 100 metres, long jump, shot, high jump, 400 metres, 110 metres hurdles, discus, pole vault, javelin, 1,500 metres.

The shot and hammer, and discus are thrown from a special circle, 7 feet in diameter for the shot and hammer, 8 feet 2¼ inches for the discus. The shot is a solid iron (or other metal) ball weighing 16 pounds minimum (7.257 kilograms). The discus is made of wood or plastic, with a smooth metal rim, its minimum weight being 4 pounds 6½ ounces (2 kilograms), diameter 8⅝ inches. The hammer is a metal sphere attached to a length of spring steel wire, its complete minimum weight being 16 pounds.

The time of 10 seconds for 100 yards was first bettered on October 11, 1890 by John Owen in the U.S.A. Championships at Washington, but in 1972 the world record stood at 9.1 seconds. The first high jump of over 6 feet was made on March 17, 1876 by Marshall James Brooks at Marston, near Oxford. The record in 1972 was 7 feet 5¾ inches. Dr. Roger Bannister, C.B.E., of England, was first to run one mile in under 4 minutes. His time on May 6, 1954 at Iffley Road, Oxford, was 3 minutes 59.4 seconds.

Atlantic Ocean is the sea lying between Europe and Africa in the east, and the Americas in the west. It is the second

largest body of water in the world, after the Pacific Ocean, and covers about a sixth of the Earth's surface. It has an area of 31,530,000 square miles, and an average depth of more than 6,000 feet. The Equator divides the ocean into the North and South Atlantic.

It was named *Atlantic* after the Atlas mountains in north-western Africa. The ocean lay beyond the mountains and was alleged to surround a legendary continent or island called *Atlantis*.

Although the Atlantic has eastern and western boundaries, it has no definite northern and southern limits, because it merges with the Arctic and Antarctic Oceans, respectively. Measured from the Arctic Circle to the Antarctic Circle, the Atlantic is about 9,000 miles long. At its widest point, it is 5,000 miles across.

A number of important islands lie in the Atlantic. Among these are the British Isles, Newfoundland, Greenland, Iceland, the West Indies, the Azores, the Canary Islands and the Cape Verde Islands. Large, open coastal waters lead off both sides of the Atlantic. These include the Gulf of Guinea, the Bay of Biscay and the North Sea on the eastern side; and Hudson Bay, the Gulf of St Lawrence, the Gulf of Mexico and the Caribbean Sea on the western side. Major semi-enclosed seas in the east include the Mediterranean and the Baltic.

The bottom of the Atlantic is divided into two deep valleys either side of a twisted ridge, the *mid-Atlantic Ridge*, that runs from north to south down the middle of the ocean. It lies at an average depth of about 10,000 feet below the water's surface, but occasionally juts above the surface in the form of islands, such as Iceland, the Azores and Tristan da Cunha.

There are a number of strong currents

The Atlantic Ocean covers one-sixth of the Earth's surface. Its greatest width is about 5,000 miles, but between Brazil and the coast of Africa it narrows to some 1,700 miles. The most prominent feature is the great Mid-Atlantic Ridge, a submarine ridge which runs down the centre of the Atlantic and occasionally rises above the sea to form islands. The North Atlantic is the greatest ocean highway in the world.

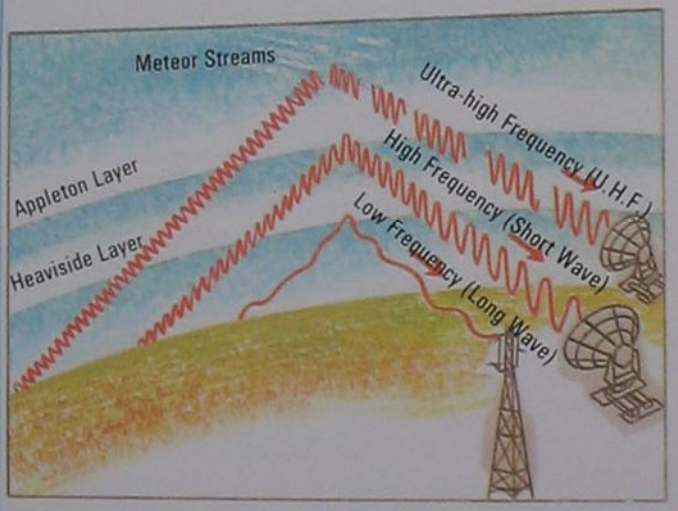
in the Atlantic. Perhaps the best known of these is the Gulf Stream. This current carries warm water across the North Atlantic from the Gulf of Mexico north-eastwards towards the coasts of Europe. It keeps western Europe comparatively warm and ice-free in the winter months. The Labrador Current, on the other hand, brings icy water from the Arctic down the eastern coasts of North America, and sometimes carries icebergs that are a danger to shipping.

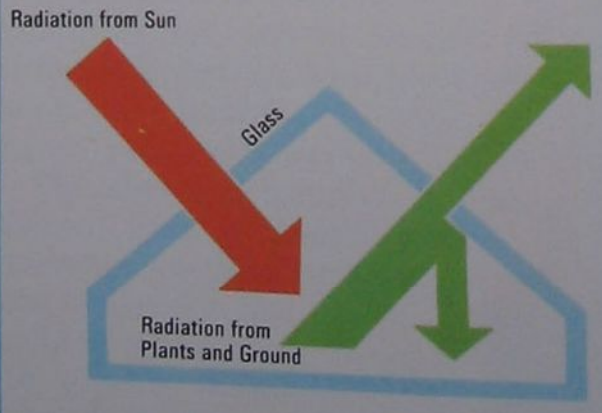
There are several parts of Atlantic coastal waters that are particularly rich in fish. Such places are the Grand Banks off Newfoundland, and the Dogger Bank in the North Sea.

Water temperature in the ocean deeps is always near freezing point, but at the surface it varies from about 80° F in the tropics to 28° F near the Arctic and Antarctic circles.

Atmosphere The entire surface of the Earth is covered by an immense 'sea' of air, stretching upwards to a height of several hundred miles. This covering of air is known as the *atmosphere*. It is usually thought of as consisting of three layers: the *troposphere*, which stretches from sea level to between 5 and 10 miles up; the *stratosphere*, which extends from between 5 and 10 miles up to 50 miles up; and the *ionosphere*, which lies beyond.

The air becomes 'thinned-out' as we move away from the Earth's surface. The oxygen that air contains is essential to all living creatures, so that man cannot survive at any great height without some kind of mechanical aid. Even at heights of three miles or less, the thinning-out of the air is very noticeable, causing an uncomfortable shortness of breath. For this reason, mountaineers,

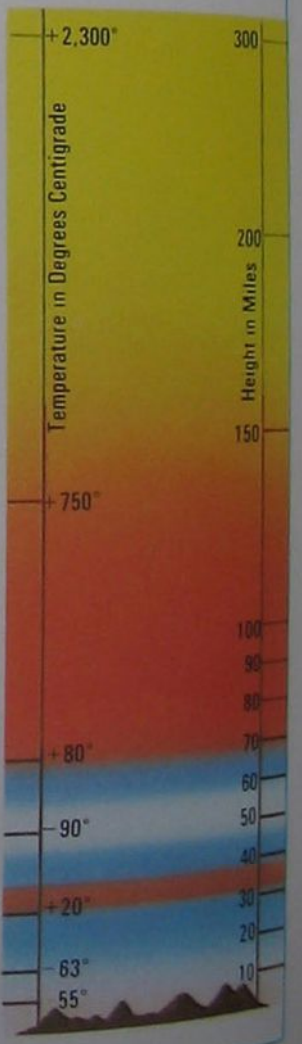




Right: Temperatures in the atmosphere.

Top left: The upper levels of the atmosphere are vital to long-distance radio communications because they reflect radio waves back to the ground, allowing them to travel around the Earth's curved surface. The Heaviside Layer reflects longer wavelengths, the Appleton Layer reflects shorter wavelengths. Very short wavelengths pass straight on into space, but they are sometimes reflected by meteor streams.

Bottom left: By letting through most of the Sun's radiation, but trapping much of the Earth's longer wavelength radiation, the atmosphere acts as a greenhouse over the Earth, keeping the temperature higher beneath it than above it.



especially when climbing the highest peaks, such as Mount Everest, are often forced to use oxygen masks.

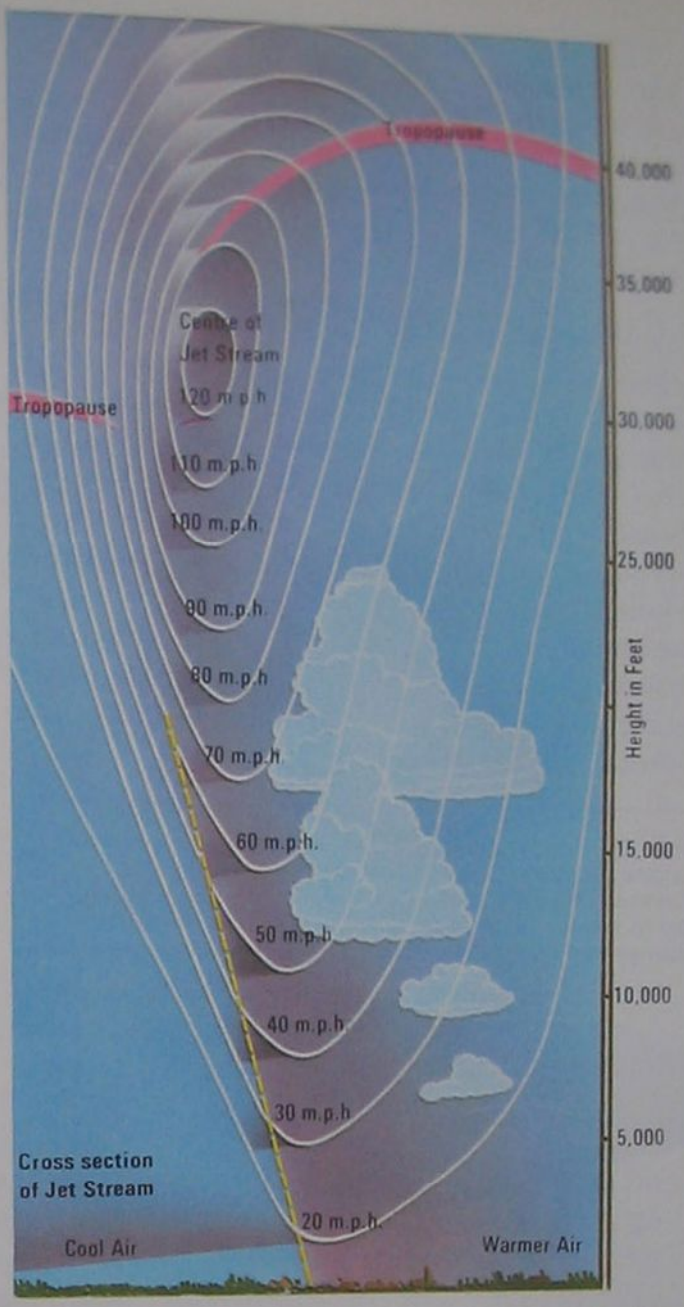
Life as we know it is possible because our Earth has an atmosphere. To appreciate the importance of the atmosphere, consider the Moon, which has no atmosphere. Temperatures in the daytime are so high that if the Moon had any water it would boil. And at night it is very much colder even than the coldest places on Earth. But on Earth the atmosphere acts as a shield during the day, protecting us from the Sun's rays, and as a blanket at night, holding the heat in.

We do not usually think of air as having weight, but in fact it has. The total weight of the atmosphere is nearly 6,000 million million tons. The column of air rising above each of us weighs about a ton and exerts a pressure of about 15 pounds on every square inch at sea level. We do not notice this tremendous pressure because the pressure inside our bodies is the same as that outside, just as the pressure inside deep-sea creatures is the same as the tremendous pressure of the surrounding water.

The higher we go in the atmosphere, the lower the pressure, because there is less air above us and, as a result, less weight of air. Thirty miles up, the air pressure is only one-thousandth of the air pressure at sea level.

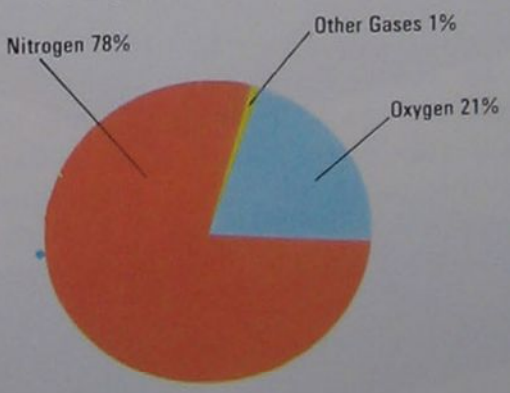
Conditions in the troposphere, the lowest layer of the atmosphere, create the world's weather. In the troposphere, temperatures usually decrease with height at the rate of 3·5° F for every thousand feet (6° C for every thousand metres). But at the boundary between the troposphere and the stratosphere above, the temperature stops falling for a while. This is called the *tropopause*. In certain places along the tropopause there are winds of over 100 miles per hour. These are called *jet streams*.

The stratosphere is generally calmer than the troposphere and is used by high-flying aircraft to avoid bad weather.



Above: A jet stream is a channel of quickly-moving air occurring at about 30,000 feet. At its centre, air is travelling at between 100 and 200 miles per hour.

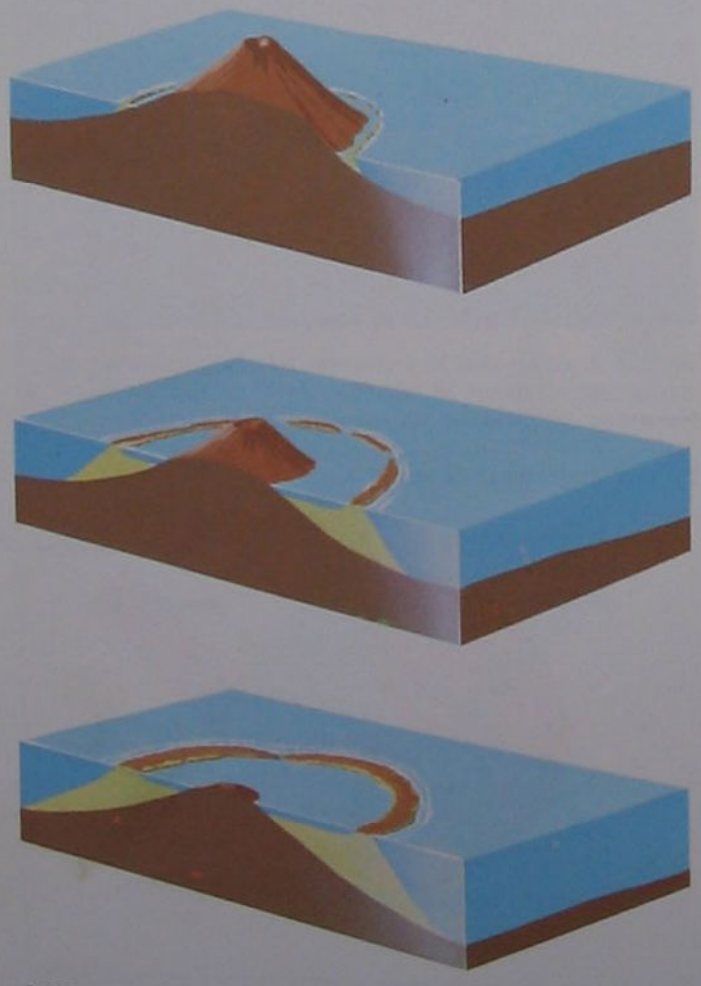
Below: The composition of air.



The outermost layer of the atmosphere, the ionosphere, is important in long-range radio communications. It reflects medium and long radio waves back to the ground, making it possible for them to travel around the Earth's curved surface.

Atoll is a ring-shaped coral island enclosing a shallow pool or *lagoon*. The lagoon is usually linked to the surrounding sea by one or more channels through the atoll. Most atolls are found in the South Pacific Ocean. The coral from which they are formed is made up of the skeletons of millions of tiny water animals called *polyps*. The sea in which these creatures live must have an average temperature of at least 68 °F., so atolls are found only in tropical seas.

How an atoll is formed. Top: A ring of coral is formed where the base of a volcanic peak meets the sea. Centre: The peak sinks down, while the coral builds up to remain above the surface. Bottom: The wind carries soil to the ring of coral. Soon trees will grow on it.



As early as 1842, Charles Darwin worked out a theory about the formation of atolls that is still generally accepted. He explained that hundreds of thousands of years ago coral reefs began to form round the base of volcanic peaks that rose above the surface of the sea. These peaks eventually sank below the water, but in the meantime the coral had continued to build up. When the peaks finally disappeared, they left behind them a more or less complete ring of coral surrounding a stretch of water.

In time, the winds blew a thin layer of soil on to the atoll, and coconuts washed ashore developed into coconut palms. In this way a typical coral island was born.

Atom Everything in the universe is made of incredibly tiny particles called atoms. Atoms are so small that if ten thousand million could be placed end to end they would measure half an inch. An atom is like a solar system in miniature. It has a central 'sun' or *nucleus* which has a number of 'planets' or *electrons* 'orbiting' around it. The nucleus itself is made of two kinds of particles: *protons* (which are electrically positive) and *neutrons*, so-called because they are electrically neutral. The orbiting electrons are electrically negative.

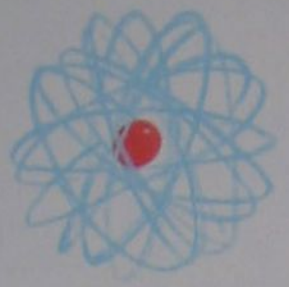
Different elements are made of different atoms, the difference being in the number of orbiting electrons (called the *atomic number*) and the number of protons plus neutrons in the nucleus (called the *mass number*).

The word 'atom' comes from the Greek *atomos* meaning 'that which cannot be divided'. More than 2,000 years ago the Greek philosopher Democritus suggested that if something was halved, then halved again, and again, then eventually there would be tiny pieces which could never be any smaller. Today, of course, we know that the atom is made of smaller particles.

Ninety-two different atoms (and therefore elements) exist in nature. Others

Top left: A hydrogen atom consists of a single electron moving round a single proton, like a planet in orbit round the Sun.

Middle left: The orbit changes its position so rapidly that it seems to weave a solid shell round the nucleus.



Bottom left: Here the orbit is shown as a shell, but cut away to reveal the proton at the centre.

Top right: A carbon atom contains six protons and six neutrons in its nucleus. Six electrons circle the nucleus, two in an inner shell and four in an outer shell.

Bottom right: Atoms are so incredibly small that if the key was enlarged until it stretched 25,000 miles around the Earth each atom in the key would still be no larger than this red ball.

have been made artificially in the laboratory. Scientists list atoms in order of atomic number in the *periodic table*.

Like our solar system, atoms are mostly space. In 1919 Lord Rutherford bombarded gold foil with particles emitted from a piece of radium and found that most of them passed straight through. Rutherford also concluded that practically all of the atom's mass is concentrated in its nucleus.

In an element atoms are held together by mutual attraction. In a *solid* this attraction is strong. In a *liquid* it is weak. In a *gas* the atoms move freely. Heating can weaken the attraction between atoms, thus changing an element from a solid to a liquid, and then to a gas.

Attila (about A.D. 406-453). In the fifth century, civilization had developed to a high degree in western Europe under the dominion of the Roman Empire. But in eastern Europe there were wandering, warlike tribes whom the Romans called *barbarians*. The Huns, one of the largest barbarian tribes, were led by Attila.

The Huns were not a united people. They lived in scattered groups, moving from place to place. The centre of Attila's kingdom was Hungary. From there he gathered the Huns together into a large army and conquered the tribes in the territory surrounding his. Eventually almost all of eastern Europe was under his control.

Threatening to attack the Roman Empire, he forced the emperor to pay him a yearly tribute to prevent attack. But he still looted towns on the edges of the empire. After several years of this uneasy relationship with Rome, Attila demanded the emperor's sister in marriage. He also required that a quarter of the empire be given to him as her inheritance. When the emperor refused, Attila stormed into the empire. But the Roman army forced him to retreat.

Two years later he invaded the empire again. He ravaged many cities before

Auckland, in the north of New Zealand's North Island, is the country's largest city and biggest importing port. From 1840 to 1865 it was the capital of New Zealand.

disease among his troops forced him to retreat once more. The following year he died, and without his strong leadership the Huns again became a scattered people.

Auckland is the largest and fastest growing city in New Zealand. It is located in the north of the North Island, on a neck of land between the harbours of Waitemata and Manukau. The city with its suburbs has a population of 603,500, and covers an area of 103 square miles. The magnificent Auckland Harbour Bridge, opened in 1959, carries eight lanes of traffic across the harbour.

Auckland is New Zealand's largest importing port, handling nearly a third of the country's total imports. It also serves the rich Waikato and Northland dairying districts that lie to the south, exporting thousands of tons of butter and other milk products each year. The Penrose and Westfield areas of the city are heavily industrialized.

Auckland's warm, pleasant climate attracts many visitors. There are some 20,000 Maoris (the original inhabitants of New Zealand) in Auckland, giving it the largest Maori population of any city in the country.

Auckland was founded in 1840 as the capital of New Zealand. It was named after Lord Auckland, then governor-general of India. In 1865 the capital was transferred to Wellington.

Auckland Province is the most northerly province in New Zealand, and covers the northern part of the North Island. It has an area of 25,420 square miles. With a population of nearly 1,100,000, it is the most heavily populated province of the country.

Auckland is the largest city in the province, and in New Zealand. The province's next largest city (fifth in the country) is Hamilton. It is located in the rich, dairy-farming district of Waikato. Another important town is Rotorua, noted for its rapidly growing iron and steel industry.

Auckland's chief river is the Waikato, which flows for more than 100 miles from

Lake Taupo into the Tasman Sea. Lake Taupo, with an area of 238 square miles, is rich in trout, and has become one of the province's major tourist attractions.

Most of Auckland's people outside the cities are engaged in dairy-farming, sheep-farming, fruit-growing, and market gardening.

Aurora is a beautiful display of lights in the upper atmosphere caused by particles shot out from the Sun. The aurora (plural *aurorae*) seen in the night sky of the northern hemisphere is called *aurora borealis*, or *northern lights*. A similar display seen in the southern hemisphere is called *aurora australis*, or *southern lights*.

Aurorae are present all the time in most parts of the sky, but can be seen clearly with the unaided eye only in the extreme north and south.

The electrically charged particles from the Sun that cause the aurorae are deflected towards the polar regions by the Earth's magnetism. The particles collide with particles in the gases of the Earth's atmosphere, causing patterns of brilliant glowing lights. The main colours are green and red. Aurorae nearly always occur more than 50 miles above the Earth's surface, and are sometimes more than 500 miles high.

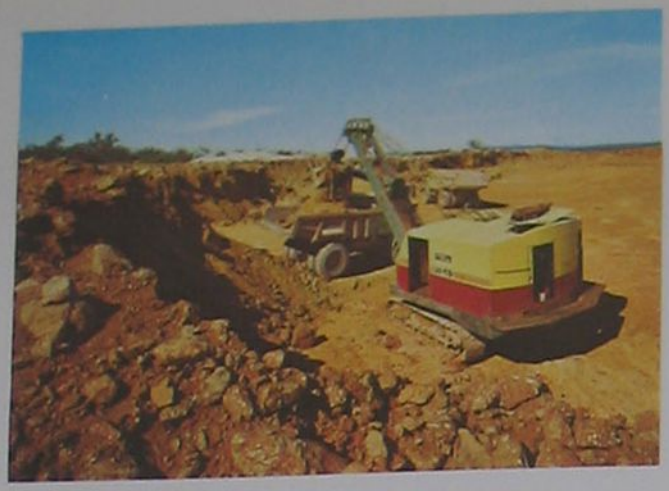
Austen, Jane (1775-1817) was an English novelist. She wrote in a polished, quietly humorous style that gently mocked many of the customs and ideas of the prosperous middle-class people among whom she lived. She was limited by an apparent ignorance of and lack of interest in the world outside her own small circle of acquaintances. The strength of her novels lay in her gift of observation.

The daughter of a clergyman, Jane Austen was born in Hampshire. Her six major works never had her name on them during her life, and two of the books appeared only after her death. *Sense and Sensibility* (1811) and *Pride and Prejudice* (1813) were both great successes. They were followed by *Mansfield Park* (1814) and *Emma* (1816). *Northanger Abbey* and *Persuasion* were both published in 1818.

A portrait of Jane Austen by her sister Cassandra.

Australasia has no agreed geographical definition. To some geographers it means Australia and New Zealand only. Others include a number of neighbouring islands. Some experts list 9 independent countries and some major Pacific island dependencies in Australasia. They include Australia, the Cook Islands, Indonesia, Malaysia, Nauru, New Zealand, Singapore, Tonga, and Western Samoa.

Australia is a country that is also an island continent. It lies in the southern hemisphere between the Indian and Pacific oceans. It is about three-quarters of the size of Europe, but Europe has 56 times as many people. Its full name is the *Commonwealth of Australia*, and it consists of six states, two mainland territories, and eight external territories. Australia is a member of the Commonwealth of Nations.



Top picture: Mining bauxite in the Darling Ranges near Perth, Western Australia. Australia possesses a plentiful supply of minerals.

Bottom picture: The 'flying doctor' is a famous Australian institution. In the remote areas known as the Outback people may live many miles from their nearest neighbour and hundreds of miles from the nearest hospital. Radio communication provides a link with neighbours and essential services.

Several islands lie around the coast. The largest and most important of these is Tasmania, which is south of the mainland of Australia. Tasmania is about as large as Ireland. The Great Barrier Reef on the north-eastern coast is a 1,200-mile chain of coral reefs and islets. It is the longest coral reef in the world.

Most of the western and central part of Australia is a large, flat plateau rising to a height of about 1,200 feet above sea level. Three deserts make up most of the region—the Great Sandy Desert, the Gibson Desert, and the Great Victoria Desert. Few people live there. Close to the east coast is a long range of mountains called the Great Dividing Range. It runs down most of the eastern side of Australia. The great Darling River rises in these mountains and then flows southwestwards for 1,700 miles, before joining the Murray River at Wentworth in New South Wales.

The northern part of Australia lies in the tropics, just north of the Tropic of Capricorn. Along the coast, it is hot and wet, with heavy rains every year. South-eastern and south-western Australia have climates similar to those of California and the French Mediterranean coast, with hot, dry summers and warm, moist winters. The east coast also has enough rain for farming. Most of central Australia has very unreliable rainfall.

Australia is rich in minerals, including bauxite, coal, copper, gold, iron, lead, nickel, silver, uranium, and zinc. Huge underground stores of water lie under parts of the country called artesian basins. The underground water is trapped in rocks deep under the surface.

Forests, particularly in the south and east, contain eucalyptus trees, which provide timber and oils. Eucalyptus are evergreen trees with bluish, waxy leaves. Australians call them gum trees. Another common tree in Australia is the acacia, sometimes called *wattle*.

Australia has only a few kinds of animals of its own. They include *marsupials*, which are animals with pouches. The biggest are the kangaroos. Others are koalas, wallabies, and wombats. The duck-billed platypus and the spiny ant-eater, mammals that lay eggs, are both Australian animals.

Most of the people of Australia are of British origin. Since World War II more than two million people from Europe have emigrated to Australia. In addition, there are about 40,000 Aborigines, a dark-skinned people whose ancestors were the first inhabitants of Australia.

More than half the people of Australia live in cities. The rest live in small towns or villages, or in lonely farms called

Cattle in northern Queensland. This is the greatest cattle state in Australia, and over 7 million are kept on huge ranches or stations.

stations. Some stations are many miles from other farms, and the people use radios and aircraft to keep in touch. Large parts of the interior are uninhabited.

Mining and manufacturing provide more than two-thirds of Australia's wealth. The rest is provided by farming. The country exports great quantities of wool and wheat. It also has many cattle and produces much butter and cheese.

There are some 26,000 miles of railways. But it is often impossible for a train to travel from one part of the country to another because three different *gauges* (track widths) are in use.

Australia has a federal form of government. This means that it is a *federation* or group of separate states, with a central government linking them together. Australia's six states are New South Wales, Queensland, South Australia, Tasmania, Victoria and Western Australia. Each state has its own parliament.

Two mainland territories come under the direct rule of the central government. They are the Northern Territory, much of which is desert, and the Australian Capital Territory, a small area around Canberra, the federal capital.

The first people to occupy Australia were the Aborigines. They arrived in the continent about 32,000 years ago.

During the Middle Ages, geographers thought there must be an enormous undiscovered continent somewhere in the southern hemisphere. They sketched it by guesswork on their maps and labelled

it Terra Australia Incognita (the Unknown Southern Land). It was not until 1606 that Australia was sighted by a Dutchman, Willem Jansz, and a Spaniard, Luis Vaez de Torres. After them, Abel Tasman and other Dutch explorers visited Australia. The region was at first called New Holland. Then in 1770 the British explorer Captain James Cook landed in Botany Bay, on the south-eastern coast, and claimed the great unknown land for Britain.

The British decided to use the new territory as a *penal settlement* – a kind of open prison where criminals could be sent, guarded by a few soldiers. In 1788, 750 convicts and their escort arrived to set up a colony at Sydney, in the south-eastern part of Australia. During the next 70 years, a steady stream of people arrived in Australia to settle.

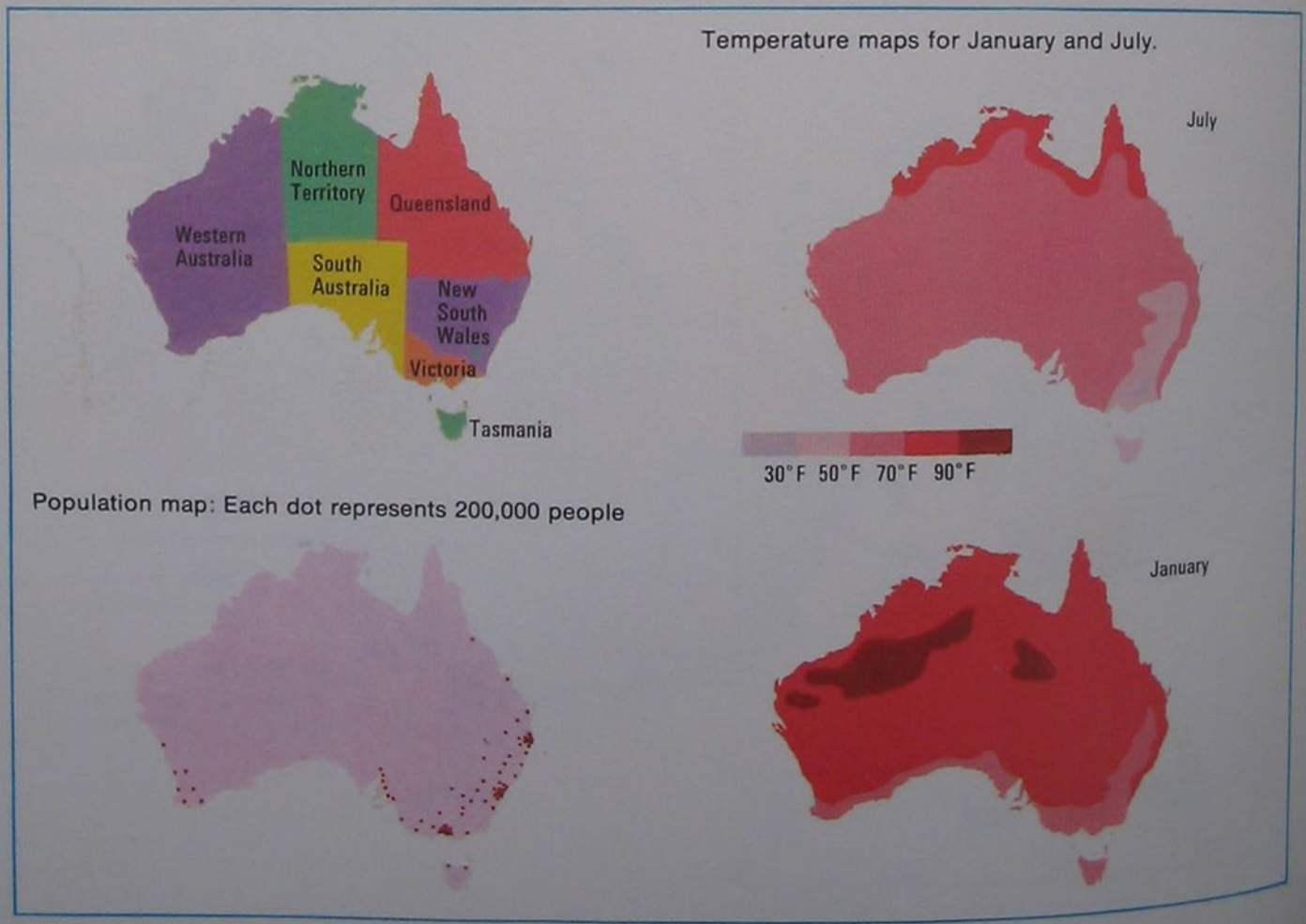
Gold was discovered in New South Wales and Victoria in 1851. During the next ten years about 700,000 people flocked to Australia to look for gold. The transportation of convicts had ceased by 1852, except to Western Australia, where it continued until 1867. Australia became an independent country in 1901 as the *Commonwealth of Australia*.

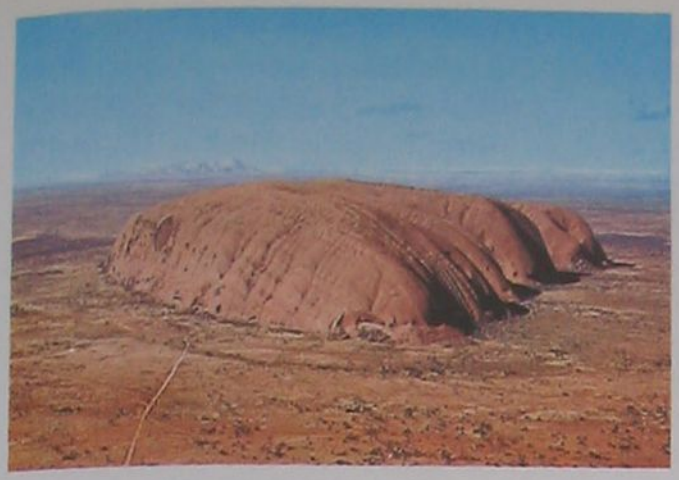
During World War I, Australian troops fought in Europe against the Germans as part of the Australian and New Zealand

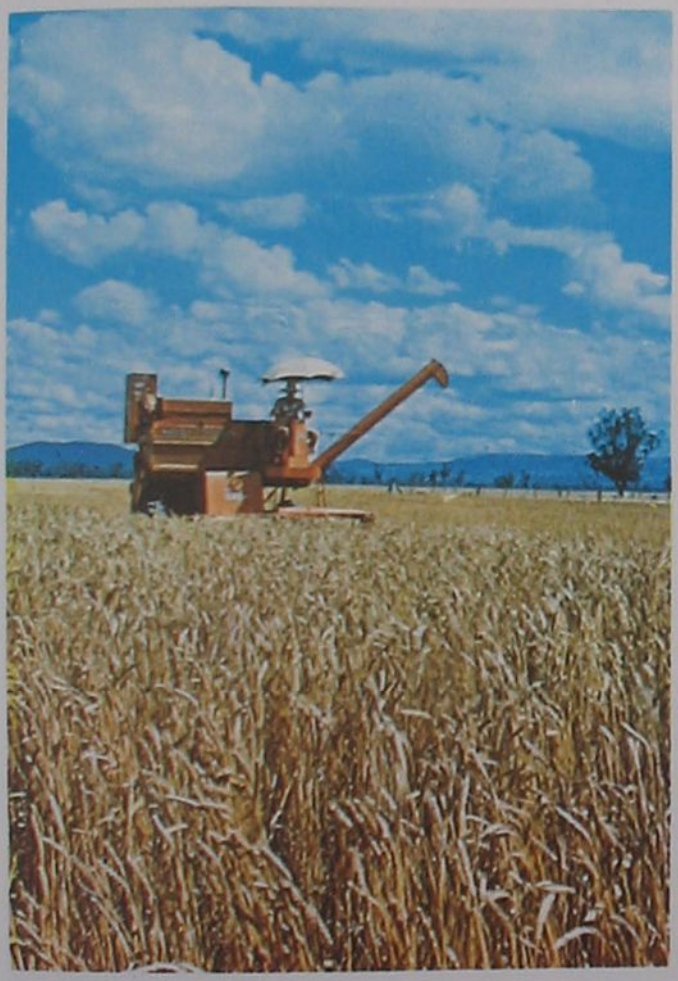
Facts and Figures
Area: 2,967,909 square miles.
Population: 12,713,400.
Capital: Canberra.
Money Unit: Australian dollar.
Labour Force: 82% urban; 18% rural.
Exports: gold, meat, wheat, wool.
Imports: chemicals, machinery, vehicles.

STATES AND TERRITORIES OF AUSTRALIA

State or Territory	*Area (sq. mi.)*	*Population*	*Capital*
Australian Capital Territory	939	139,800	Canberra
New South Wales	309,433	4,623,900	Sydney
Northern Territory	520,280	74,100	Darwin
Queensland	667,000	1,820,000	Brisbane
South Australia	380,070	1,177,800	Adelaide
Tasmania	26,383	395,600	Hobart
Victoria	87,884	3,480,800	Melbourne
Western Australia	975,920	1,001,300	Perth







Above: Australia is the stronghold of the marsupials—the pouched mammals. The young of marsupials are born in a relatively unformed state and continue their development in their mothers' pouch.

Top left: Ayers Rock, a famous landmark of Central Australia.

Bottom left: Harvest in New South Wales. The main wheat-growing areas are the Murray-Darling plains and the south-western corner of Western Australia. Australia exports large quantities of wheat.

Below: Australia has 164 million sheep, and accounts for almost half the world's wool exports.

Army Corps (the Anzacs). Their bravery in attacking Germany's allies, the Turks, at Gallipoli in 1915 won them undying fame. During World War II, Australian forces fought against the Germans and Italians in northern Africa and against the Japanese in New Guinea.

Before and after World War II, Australia grew both in population and wealth. More and more gold, wool and other Australian products were sold to other countries, and more people came to settle there. In 1965, Australian troops went to fight in the Vietnam war.

Talking points

* Give reasons why thousands of people emigrate to Australia each year.
* Australia has many strange animals not found elsewhere. List as many as you can and explain how this came to be.
* Compare Australia's treatment of the Aborigines with America's treatment of Red Indians.

Articles to read

See under Australian states and chief towns. Also: Aborigines; Anzac; James Cook; Darling River; Great Barrier Reef; Marsupials; Monotremes; Snowy Mountains.

Austria is a mainly mountainous country in the centre of Europe. About three-quarters of Austria lies in the Alps. The highest peak is the Grossglockner (12,461 feet). The valleys of the rivers Inn, Salzach and Enns provide passes through the mountains. For example, the Brenner Pass allows people to travel through the mountains to Italy and Yugoslavia. Trees cover much of the Alpine area.

North of the Alpine area lies a lower plateau, through which flows the River Danube. Farmers cultivate more than half of this region.

East of the plateau lies the Vienna Basin, a rich, fertile valley. The Danube flows through this region and forms an important means of transport.

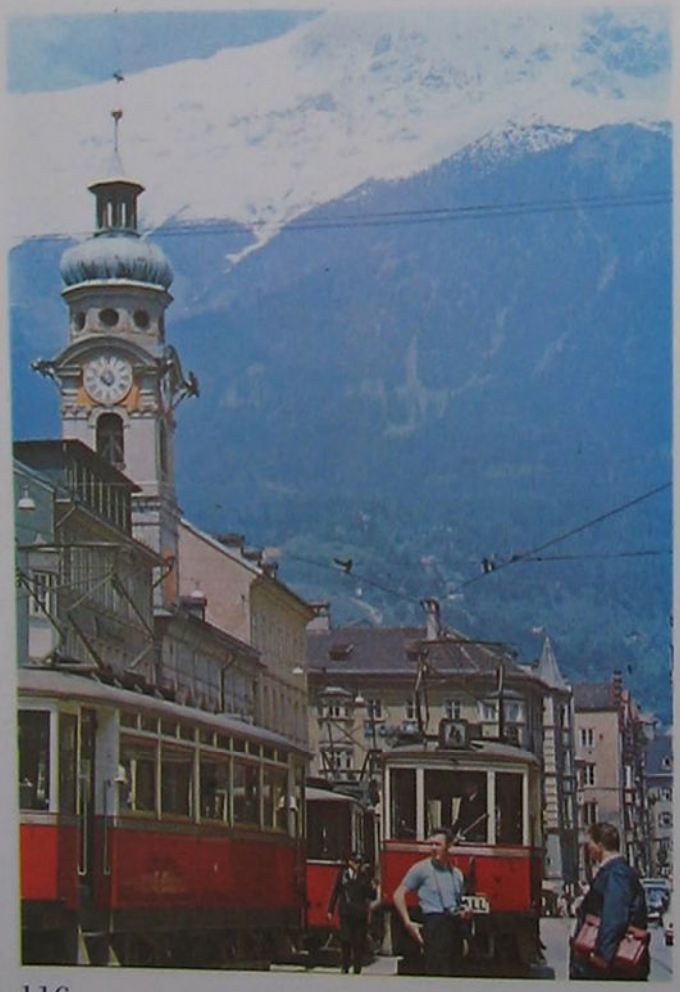
Austria's natural resources include huge reserves of timber. The country is rich in minerals, including iron ore, lignite, copper, gold, and silver. Most of the country's power comes from hydro-electric stations in the Alps.

The people of Austria are mostly German-speaking. They have close ties with the people of Germany.

In 1867, Austria granted the province of Hungary equal status within the Austrian empire, which then became the Austro-Hungarian empire. In 1918, the Austro-Hungarian empire broke up, and Austria was left with about the same territory that it has today. It then became a republic.

In 1938, Austria was occupied by the Germans. It regained its independence in 1955. During the late 1960's Austria became one of the most highly industrialized countries in Europe.

Facts and Figures
Area: 32,374 square miles.
Population: 7,400,000.
Capital: Vienna.
Money Unit: Schilling.
Exports: aluminium, machinery, textiles, wood products.
Imports: coal, foodstuffs, machine tools.



Above: The famous Vienna Opera House.

Far left: Its beautiful situation, in the Alps, and architectural treasures, make Innsbruck a popular tourist centre.

Near left: Location map of Austria (marked in black).

Automation In some of the world's biggest factories, there is scarcely a man in sight. Yet all around machinery is turning and products are being made. How is this possible? By *automation*, or the automatic control of machines.

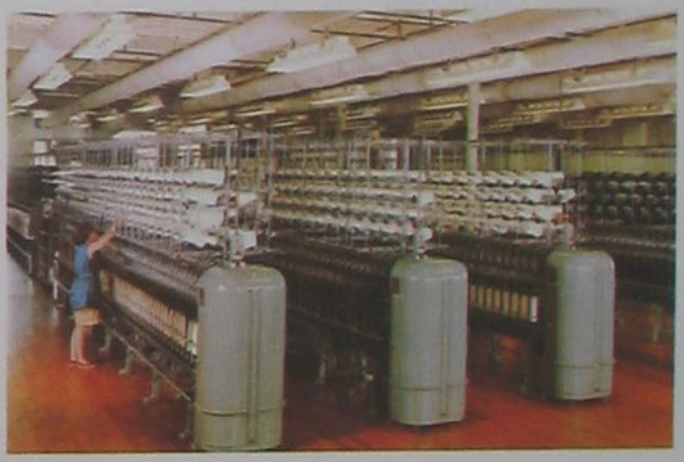
The machines are controlled not by workers turning knobs or pulling levers, but automatically by a series of 'instructions' fed into them on punched cards or magnetic tape. All an operator has to do is to insert the card or tape into a control unit for the machine and press the starting button. Sometimes he does not even have to do that. The machine may be under the remote control of a computer, or 'electronic brain'.

Information about what the machine *is* doing is fed back constantly to the control unit. There it is compared with what the machine *should be* doing. If there is any difference, the machine corrects itself instantly. This kind of *feedback* of information makes the machine self-regulating and is the real key to automation. The devices that control and correct the machines are called *servomechanisms* (see Servomechanisms).

Automation is widespread in the petroleum and chemical industries, where the processes involve the flow of liquids and gases at certain temperatures and pressures. Self-regulating devices for flow, temperature and pressure are relatively simple.

The word automation is also used to describe the use of machinery to save manual labour. The trend in industry over the last two hundred years has been towards increasing mechanization and the streamlining of production techniques.

Automobile To many people, life without the automobile would be unthinkable. It has influenced their whole pattern of living—where they live and work and how they spend their leisure time. In the United States, the world's largest



Above: A modern textile factory.
Left: A section of a car assembly line.
Below: Early automation. Women workers in a Victorian pen factory.

producer of automobiles, there are more than 62 million vehicles—one to every three people. In Europe, there is one to about every eight or nine people.

Modern automobiles are fast, sleek, and comfortable—quite different from the bone-shaking 'horseless carriages' of the late 1800's. But the first motor vehicles appeared at least 200 years ago. They were driven by steam and were slow, noisy, and often dangerous. From the 1830's onwards, electric cars driven by batteries were developed. They were faster and quieter but could only travel a short way before the batteries needed recharging.

In 1860, Jean Lenoir built in France the first successful engine using *internal combustion*—burning a fuel inside a cylinder. And this is the principle on which automobile engines work today.

In 1885, two German engineers, working independently, produced vehicles which can be considered the forerunners of today's automobiles. The engineers, Karl Benz and Gottlieb Daimler, both used internal combustion engines with petrol (gasoline) as fuel.

In 1913, Henry Ford introduced in the United States a successful method of mass production in which the automobile was assembled part by part by semi-skilled labour. The automobile moved down a line of workers who each assembled a certain part of it. This method of assembly-line production using conveyor belts is the one used to make cars today.

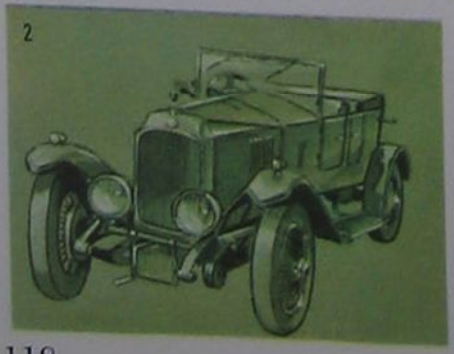
Development during both World Wars was rapid. Engines were improved to give greater power. Automobiles became more reliable and easier to drive.

The *engine* of the automobile provides the power to turn the car wheels. It may be at the front or the back of the car. The engine power comes from burning a mixture of petrol and air in the *cylinders*. Most engines have four or six cylinders in a straight line.

Inside each cylinder is a close-fitting *piston* which can move up and down. The gases produced by burning the fuel push the piston down. The pistons are connected to a *crankshaft* and force it round. At one end of the crankshaft is a heavy *flywheel*, which smooths out the motion. Power from the engine is transmitted to the wheels by the *transmission system*.

Most engines work on what is known as

1. Model T Ford
2. Vauxhall 30/98
3. 1896 Ford Quadricycle
4. A modern M.G.C.



the *four-stroke cycle*. This means that the piston only produces power on one out of four *strokes*, or movements. Some engines work on a *two-stroke* cycle and produce power on every downward stroke.

Fuel for the engine is provided by the fuel system. Most cars use petrol as fuel. The petrol is stored in a tank away from the engine and forced by a *petrol pump* along a pipe to the *carburettor*. In the carburettor, the petrol mixes with air drawn in by the engine to form a fine spray that burns easily.

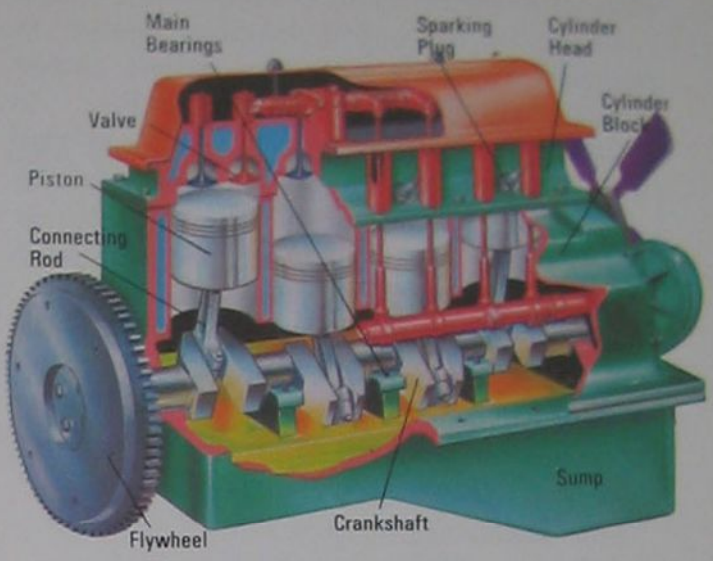
The petrol mixture enters the engine cylinders through mushroom-shaped *valves* and is ignited by a powerful spark produced by the ignition system. Two devices called a *contact breaker* and an *ignition coil* can use the power of the automobile's battery to produce a spark.

The spark is produced in the cylinder when electricity 'jumps' across a gap between the metal points of a *sparking plug*. The sparks are needed in the cylinders at different times. A rotating arm in the *distributor* 'distributes' the electricity to each sparking plug in turn.

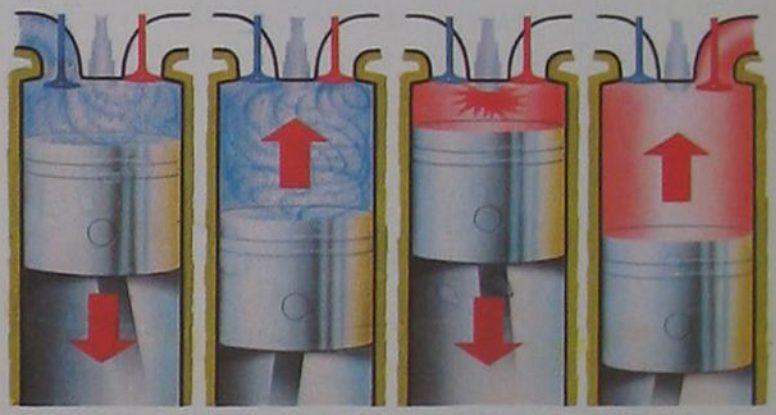
The majority of automobiles have the petrol engines described above but some have *diesel* engines, like most heavy trucks. Diesel engines differ from petrol engines because they have no sparking plugs or carburettors. Diesel oil is injected into the engine directly and burnt by the heat of air compressed in the cylinders. It thus works by compression ignition rather than by the spark ignition of petrol engines. Fuel injection is also used in some petrol engines.

The battery is charged continually while the engine is running by the *dynamo*. It provides power not only for ignition but also for the starter motor to start the engine, the lights, the horn, and the windscreen wipers.

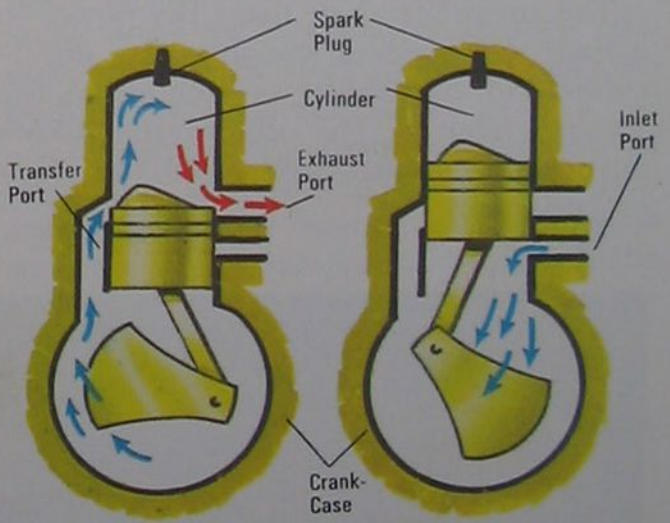
When fuel burns inside the engine cylinders, it produces a lot of heat. This heat must be removed if the engine is to work properly. Most engines are cooled by circulating water through them. But



A four-cylinder engine with its cylinders in a straight line. This is a common arrangement.



The stages of the four-stroke cycle of the petrol engine —induction, compression, ignition (power) and exhaust. Only one in every two downward strokes produces power.



The stages of the two-stroke cycle.
Left: Exhaust and transfer
Right: Inlet and compression

some are cooled by blowing air over them.

In a water-cooled engine, water is pumped through passages called *water jackets* surrounding the cylinders. It absorbs heat there and passes into the tiny tubes of the *radiator*. A fan driven by the engine draws cold air over these tubes to cool the water. The colder water then returns to the engine.

The many moving metal parts in the engine must be continually oiled, or lubricated, to prevent wear. Oil from a trough called a *sump* is pumped through a *filter* to the moving parts.

The transmission system of the automobile transfers power between the engine and the road wheels. A driver uses the *clutch* to disconnect the engine from the rest of the system when he wishes to change gear or stop.

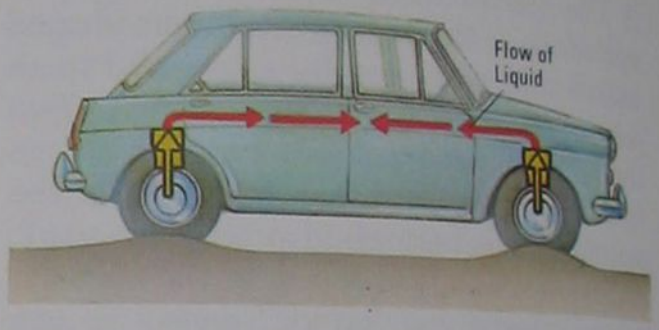
The *friction* clutch contains sprung metal plates and the *fluid* clutch contains oil to transfer power between the flywheel and the gearbox.

The driver changes gear to make his automobile go faster or slower for the same engine speed and to reverse, or go backwards. The *gearbox* consists of a number of toothed wheels of different sizes which mesh together to turn at different speeds. In cars with *automatic transmission*, the gears change automatically.

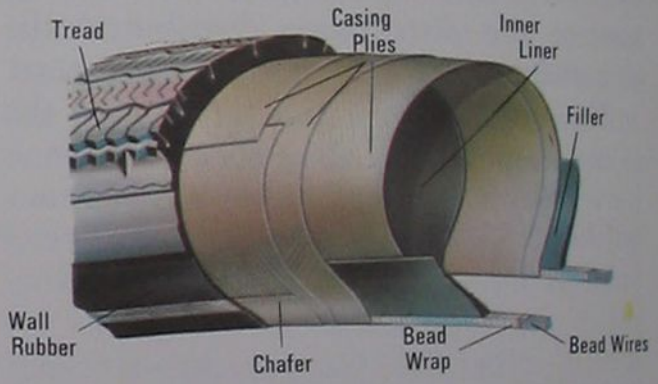
The *propeller shaft* takes the power to a *final drive*, which consists of a *differential* and *half-shafts* connected to the driving wheels. The differential allows one wheel to turn faster than the other on cornering.

Hydrolastic suspension

The diagrams show how the liquid moves when the car hits a bump.

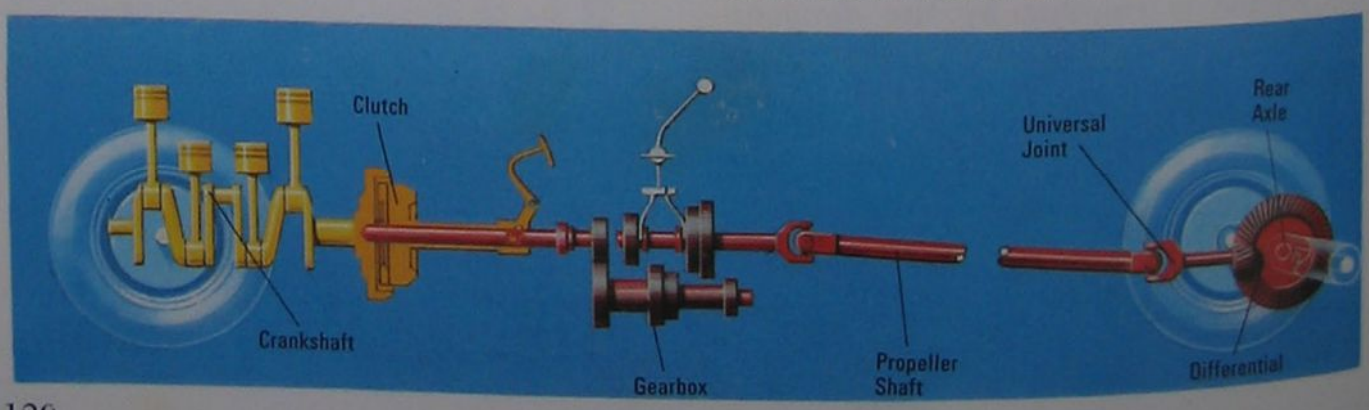


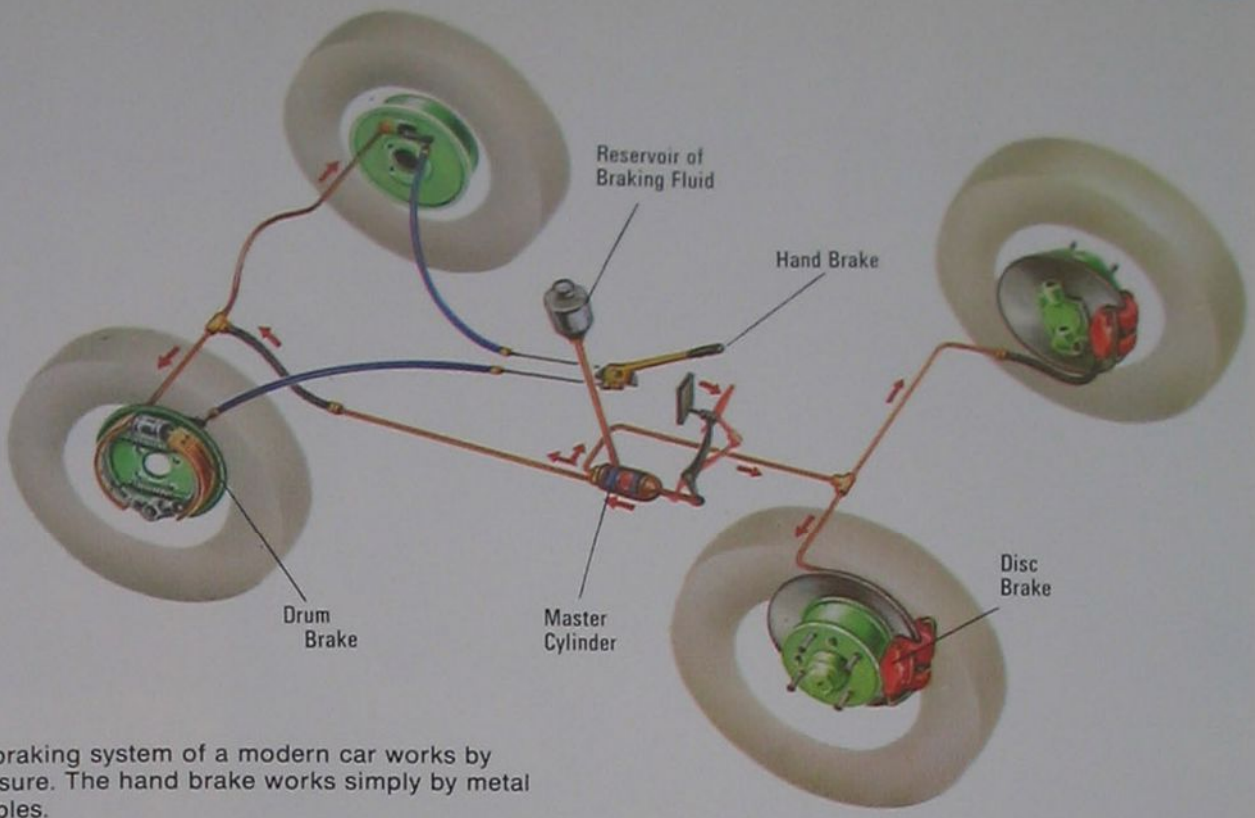
Cutaway section of a tubeless tyre



Tyres can have many different kinds of tread. Those with coarse treads are ideal for rough country. The construction of a modern tubeless tyre is shown here.

Below: Power from the up-and-down movement of the pistons travels through the transmission system to drive the rear wheels of the car.





The main braking system of a modern car works by liquid pressure. The hand brake works simply by metal rods or cables.

The driver steers his automobile by turning the *steering wheel*. This movement travels down the *steering column* into the *steering box*, and from there by a system of rods and arms to one of the road wheels. The two wheels are connected by the *track rod* so that one turns with the other. The system is so designed that the inner wheel turns more sharply than the outer one when travelling round corners.

The braking system of an automobile is designed to stop it swiftly and safely. Every car has two independent systems, the *foot brake* and the *hand brake*. The foot brake acts on all four wheels and acts by hydraulic (liquid) pressure. The hand brake acts on the back wheels only and is linked to them by rods or cables.

Each wheel has a brake drum or disc on it. When the driver applies the brakes, a pad of hard material called a *brake lining* is forced against the drum or disc and slows it down.

For a comfortable ride, every automobile must have an efficient suspension system. Most suspension units include springs over each wheel to cushion the vehicle from bumpy roads. In *independent suspension*, each wheel can move up and down without affecting the others. *Dampers*, or *shock absorbers*, are included in suspension systems to prevent the vehicle bouncing on the springs too much.

The bodies of some automobiles are made of fibre-glass, but most are made of steel sheet by *integral*, or *unitary construction*. Huge steel presses shape the body as a strong, rigid shell.

The other body parts and mechanical units are attached to the shell. Some automobiles and heavy vehicles have a separate frame, or *chassis*, on which the body and other units are mounted.

Talking points

* Consider some of the ways in which the car has affected modern life.
* How could travelling by car be made safer? Look at car design and road safety.
* What effects have road vehicles had on the environment? Remember exhaust fumes, damage to buildings from vibration caused by heavy traffic, and the effects on the countryside.

Articles to read

Henry Ford; Internal combustion engine; Roads; Road transport; Safety.

Avalanches of snow and ice can easily bury people. This dog is trained by a Swiss avalanche rescue service to seek and dig out people hidden beneath the snow.

Avalanches are landslides of snow and ice that come crashing down the side of a mountain. Rock, earth and other debris may be carried along too. Because they occur unexpectedly, avalanches pose a danger to skiers, climbers and valley residents, who may become trapped under many feet of snow.

Avalanches can occur whenever the weight of accumulated snow becomes too great, or when the mass suddenly shifts because of wind, spring melting, or a loud noise such as thunder or the blast of an explosion.

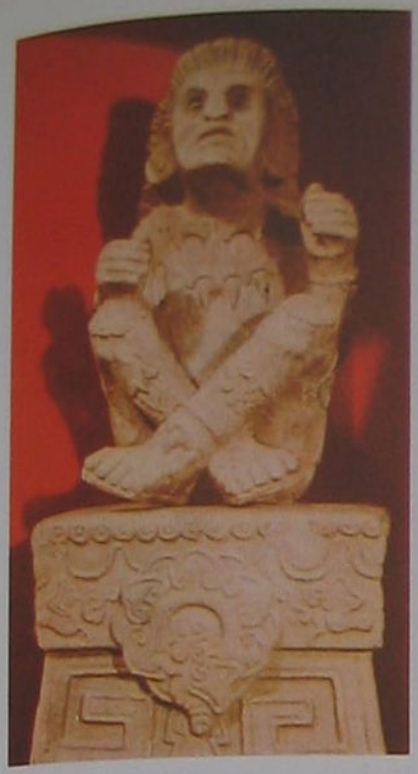
Ayrshire, a county in the Lowlands of Scotland, borders the Firth of Clyde in the south-west of the country. Its county town is Ayr; its area is 1,132 square miles.

The three ancient divisions of Ayrshire, from north to south, are Cunningham, Kyle, and Carrick. The northern part of the county is industrialized, the main industries being engineering and the manufacture of textiles. There are deposits of coal and iron, though some important earlier coalfields are now worked out. Kilmarnock is the chief industrial town. There is a nuclear power station at Hunterston.

In central and southern areas, the people live mainly by farming, chiefly dairy farming: a famous breed of cows is named Ayrshire. Potatoes and some wheat are grown.

The coast has many tourist resorts, and the county is popular with anglers and golfers. Alloway, near Ayr, was the birthplace of the poet Robert Burns.

Aztecs The valley of Mexico was a superb place in which to live. It was 7,000 feet above sea level, walled in by high mountains and immensely fertile. The water from the mountains and the lake system made irrigation easy. Artificial islands were made on rafts in the lake. Decaying water-plants and dung enriched the soil. There were two or three harvests a year. Many tribes settled around the lake; there was no need to keep moving as in the forests to the south (see Mayas). But the richness of the valley tempted barbarian Indians from the north.



Far left: A statue of Xochipilli, one of the Aztec gods. He presided over Pleasure, Feasting, and Frivolity, and was also believed to control the maize crop.

Above: A sacrificial knife of the Fourteenth Century which can be seen in the Smithsonian Institution, in Washington D.C.

Left: A rock crystal skull made by the Aztecs in the Fifteenth Century. It is $8\frac{3}{16}$ inches long and is now in the possession of the British Museum.

For a thousand years or more civilisations like the Olmecs and the Teotihuacans flourished in different parts of Mexico. About the tenth century A.D. Toltecs from the north occupied the area. In the thirteenth century civil war weakened the Toltecs and a new wave of invaders entered the valley of Mexico. Among them was a tribe called Tenochcas.

Aztec society emerged in the next three centuries. Towns were tribal centres. One tribe or town after another rose to power. The Tepanecs whose city was Azcapotzalco overthrew the Texcocans. The Tepanecs were defeated in their turn by an alliance of the defeated Texcocans with Tenochtitlan of the Tenochcas and Tlacopan. Texcocan power was restored but only in alliance with the Tenochcas. The ruler who had brought the Tenochcas to the front was Itzcoatl (1428-40). He was succeeded by Montezuma I (1440-69). Montezuma II (1503-20), grandson of Montezuma I, raised the Tenochcas to the supreme position in the valley. Other city states paid a regular toll of human victims for the mass sacrifices that the Tenochca practised.

In 1519 Spaniards led by an adventurer, Hernando Cortés, reached the valley of Mexico. By allying with various subject tribes Cortes was able to overthrow Tenochcan rule and create a Spanish colony. The death toll was immense. There were fierce battles in and around the lake and European diseases killed hundreds of thousands of Indians. Tenochtitlan was destroyed and Mexico city built on the site. (See Incas).

B

Babylonia Babylon was a city on the river Euphrates, founded by Semitic settlers from the deserts. Quarrels between the Sumerian cities gave the Babylonians their opportunity. They began to conquer the neighbouring tribes about 2000 B.C.

The most famous Babylonian king, Hammurabi (1711-1669 B.C.), was the first to establish his rule over the whole of Mesopotamia (the land between the rivers Tigris and Euphrates). This area now

Above: A headdress with gold ornaments which was dug up at Ur, one of the major cities of ancient Babylonia. It probably dates from around 2000 B.C. Left: A reconstruction, in the Berlin State Museum, of the Ishtar gate of Babylon. It is decorated with glazed-brick reliefs of fabulous beasts. Ishtar was a goddess to whom temples were built in most Babylonian cities.

became known as Babylonia. Hammurabi drew up a code of law for his people which had a strong influence on the Mosaic Law of the Hebrews. It covered an enormous range of subjects: property, military service, banking, the legal rights of women and children and many other topics. Hammurabi was a poet and scholar and built up an enormous library. Babylonian records were written in cuneiform on clay tablets. Cuneiform takes its name from the wedge-shaped marks which the reed stilus (pen) made on the clay. Babylonian weights and measures, their currency and their language spread all over the Middle East. Law and order were maintained from Mesopotamia to the Mediterranean, to which the Babylonian Empire stretched. Religion was very important in Babylonia. The priests were wealthy and the king himself claimed to be a god.

After Hammurabi's death various tribes within the Babylonian Empire revolted and after the sack of Babylon in 1515 B.C. the Kassites founded a new ruling dynasty (family). In 1097 B.C. the Assyrians (see Assyrians), a fierce neighbouring tribe, conquered Babylon; but their empire did not last long. By 626 B.C. a new Chaldean dynasty had been established in Babylon. This empire reached its peak under Nebuchadnezzar (605-562 B.C.), who built temples, palaces and the 'hanging gardens of Babylon', one of the seven wonders of the Ancient World.

The Chaldeans were skilled mathematicians and astronomers. Their detailed records of the movements of the planets and eclipses were studied and explained by Greek scientists. This empire in turn was conquered by the Medes and Persians. By 540 B.C. the whole of Babylonia was ruled by Cyrus, the Great King of Persia.

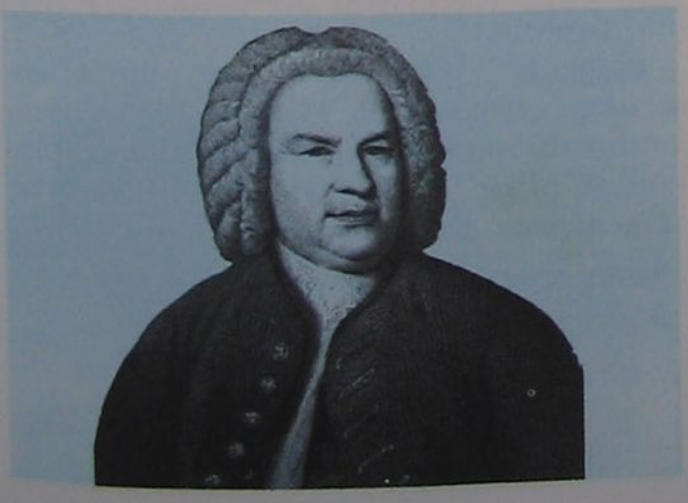
Bach, Johann Sebastian (1685-1750), was born in Eisenach, Germany, to a family of musicians whose tradition went back several generations and was to continue, through his own sons, for several more.

Many people think Bach's greatest masterpieces are the Passions *according to St. Matthew and St. John, and his* B Minor Mass, *written while he was in Leipzig.*

There were more than sixty musical Bachs before the family died out in the 1800's.

Johann Sebastian was brought up by his musical elder brother after their father died in 1695. The boy studied music passionately, creeping out of bed to copy his brother's collection of music by the dim light of the moon. This copying by moonlight ruined his weak eyesight and later led to blindness. But the copying also had other effects. It helped him to absorb the musical style of Italian and French composers whose works he heard only infrequently. Later, he began to imitate these styles. And later still he evolved his own style from a fusion of the Italian and French styles together with that of his native Germany, with its characteristic love of wind instruments and *counterpoint* (two or more melodies chasing and overlapping one another).

Johann Sebastian's composing life can be divided into three main periods. In the first, beginning in 1708 with his appointment as organist at Weimar and continuing until 1717, he composed much of his great organ music. In the second period, from 1717 when he worked as music director at the court in Cöthen until 1723, he composed most of his orchestral music, including his Brandenburg concertos. And in the third period, from 1723 to his death in 1750, he composed most of his finest choral music and more music for organ. At this time he worked as organist, teacher and composer for three churches in Leipzig, the main one being St. Thomas's.



Bacon, Francis (1561-1626), was an English statesman, thinker, and writer. Unlike most philosophers of his time, he understood the importance of a scientific approach to knowledge. He urged that men should not form theories on any subject until they had investigated all the facts that applied. His books include *The Advancement of Learning* and *Essays*.

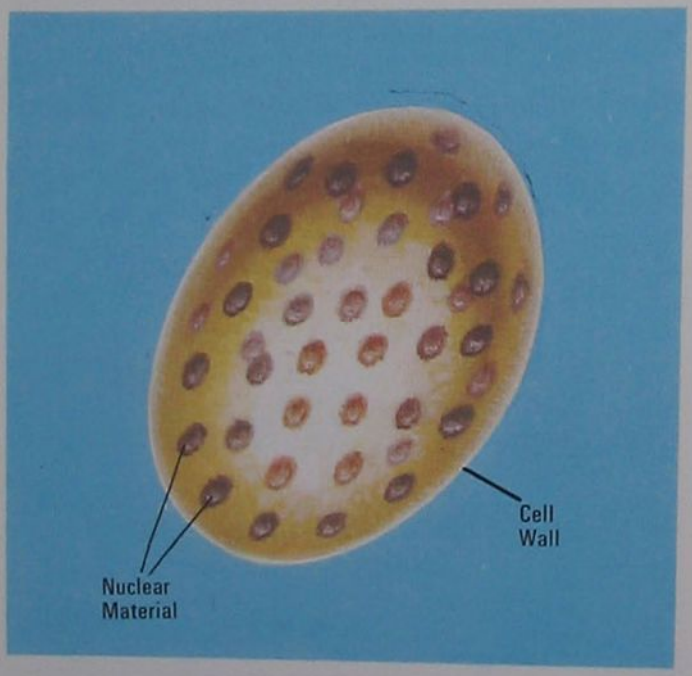
Bacon was educated at Cambridge, and became a lawyer. King James I valued his advice and made him Lord Chancellor in 1618. Bacon was given the title Baron Verulam, and was later created Viscount St. Albans. In 1621 Parliament convicted him of taking bribes, and he was forced to leave public life.

Bacteria are minute, single-celled organisms whose effects on other living things are out of all proportion to their tiny

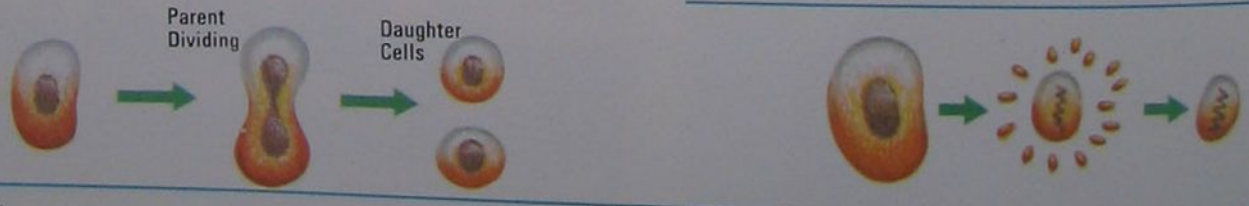
Part of a Bach manuscript. Left: A contemporary print of Bach.

Some disease-causing bacteria, greatly magnified

A diagram showing the typical structure of a bacterium. Note the distinct cell wall and the distribution of the nuclear material throughout the cell.



Below: Reproduction in bacteria often takes place by cell division (left). The nuclear material and the protoplasm are shared out between the two daughter cells. Some bacteria reproduce by spore formation (right). The parent spore breaks up to produce new spores.



size. Most bacteria are only about one-thousandth of a millimetre in diameter and are a lot smaller than most other single-celled organisms. But without the help of this vast invisible army, all life would cease to exist. Bacteria can be grouped by the way they live. A few kinds make their own food, but most of them live off dead or decaying matter (as *saprophytes*), or off living organisms (as *parasites*).

Saprophytic bacteria are extremely important to biology as decomposers. Dead animals and plants decay through the action of bacteria, which consume the organic parts and return them, eventually, to the soil. Without the aid of bacteria, energy would remain locked up in undecomposed dead matter accumulated since life began. Many bacterial decompositions are put to good use by man. He purifies sewage, produces cheese, cures tobacco, and prepares flax with their help. But, at the same time, other bacteria turn meat rotten, sour milk, and make butter rancid, while they obtain food energy for their own purposes. One of the most important contributions of bacteria is the part they play in making nitrogen available to plants. Nitrogen gas is abundant in the atmosphere, but animals and plants have no means of converting it into useable forms. However, certain kinds of bacteria that live in the soil or in the roots of legume plants such as clover and beans, are able to convert nitrogen gas to nitrites and nitrates, which are eventually built up by plants into proteins.

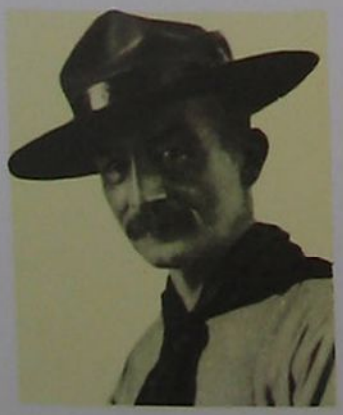
Parasitic bacteria cause numerous serious diseases of man, including tetanus, tuberculosis, diphtheria, and various kind of blood poisoning. Before the use of antiseptics, these so-called *pathogenic*

bacteria caused misery and death in colossal proportions, and rendered even the simplest surgery hazardous. Nowadays, surgery is carried out in germ-free rooms with apparatus previously steam-heated under pressure to kill all forms of bacteria.

Bacteria reproduce by the division of their single cell into two identical parts, and in favourable conditions new generations occur every twenty minutes. Some bacteria can move in water. They either wriggle about, or have whip-like hairs to help them 'swim'.

Baden-Powell, Lord (1857-1941), was the founder of the Scout and Guide movements. His full name was Robert Stephenson Smythe Baden-Powell. In 1876 he joined the 13th Hussars and served with distinction in India, Afghanistan, and Zululand. He won fame in the Boer War (1899-1902) in South Africa for his defence of Mafeking, and rose to the rank of major-general.

As a result of his army experiences, Baden-Powell came to the conclusion that British boys needed more physical training and greater experience of outdoor life. He founded the Boy Scout movement in 1908 and, with his sister Agnes, the Girl Guide movement in 1910. At an international *jamboree* (gathering) in London in 1920, Baden-Powell was acclaimed as World Chief Scout. There are now boy scouts and girl guides in countries all over the world. They learn to develop their characters by organized work and games, and learn many skills, such as camping, signalling, cooking, and first aid.



Baden-Powell in 1914. The Scouts' uniform was modelled on that of the South African Constabulary, which he had raised under Lord Roberts after the Boer War.

Badger The badger is a short-legged, burrowing mammal about three feet long. Badgers have coarse silvery-grey or brownish hair on their bodies. Distinctive black and white stripes extend along their heads from the snout to the neck.

In Europe and Asia, badgers live in woodlands and fields, but the American species live on open plains. They both live in deep burrows, where they sleep by day. At night, they come out and hunt for food. They eat mainly small animals, such as rats, mice and young rabbits, together with insects, snails, and some plant food such as berries and roots.

The Common badger. The American badger, which looks very similar, is in fact only a distant cousin.

Badminton is an indoor version of lawn tennis, in that it is played over a net, either 'singles' or 'doubles', with a similar, but lighter and narrower, racket, and a shuttlecock replacing the ball.

The shuttlecock consists of goose feathers about 2½ inches long fixed into a half-sphere of cork about 1 inch in diameter, the rounded end being leather covered.

The doubles court is 44 feet long and 20 feet wide, with a net across the middle hanging exactly 5 feet above the floor at the centre. Singles is played on a re-

stricted area of the doubles court, the width of the court being reduced to 17 feet.

The shuttlecock is served diagonally, and remains in play as long as it is kept within the court and off the ground. All shots are volleys. Scoring goes up in single points, and only the serving side can score. A server winning a rally advances his score by one point; if he loses a rally the score remains the same but the service changes. A game consists of 15 points, and 3 games make a set.

The shuttlecock does not bounce and so all strokes in Badminton must be made on the volley. The object of the feathers is to slow up the speed of the cork base, but when the shuttlecock is struck hard (right) it can travel extremely fast.

Badminton is thought to have originated in India as 'Poona'. It was brought to England in 1873 when it took its present name through association with Badminton Hall, the seat of the Duke of Beaufort, in Gloucestershire.

The English Badminton Association was formed in 1893. After World War I its popularity began to spread. The International Badminton Federation was formed in 1934; and the International Championships (Thomas Cup) were started in 1948. Malaysia and Indonesia have both been International Champions four times.

Baffin Bay is the part of the Atlantic Ocean separating Greenland from Baffin Island. It belongs to the Canadian North-west Territories. Baffin Bay is joined to the Arctic Ocean on the north and the west. This vast bay is about 700 miles long and from 70 to 400 miles wide.

This great area of water is frozen solid for most of the year. It is open to shipping for only a few months in the summer, but dangerous icebergs still float on its surface. Animals found in the bay include seals, walruses and whales.

The English navigator and explorer William Baffin discovered the bay in 1616. Baffin was trying to find a north-west passage to the spice lands of the East Indies. His name was given to both Baffin Bay and nearby Baffin Island. This has an area of 183,810 square miles.

Baghdad (pop. 1,884,151) is the capital of Iraq. The city stands on the River Tigris, and is the commercial and industrial centre of the country. Exports of hides, skins, wool, silk, and cereals are distributed through Baghdad. The city was founded in 762 A.D., on the site of an ancient Babylonian town. It quickly became an important route junction. It developed into a centre of Muslim learning and culture, and was known as the 'Abode of Peace'. Its magnificence was highlighted in the stories of the *Thousand and One Nights*.

Baghdad was destroyed by the Mongols in 1258, and again by Tamerlane in 1400. The rebuilt city was captured by the Turks in 1638, and remained part of the Ottoman Empire until World War I. It was made the capital of independent Iraq in 1921.

Bahamas These are a group of islands in the West Indies. They stretch for about 700 miles from the south-eastern coast of Florida as far as the north-east of Cuba.

The islands cover an area of about 4,404 square miles. They have a popu-

Fruit and seafood on sale at a quayside market in Nassau, the capital of the Bahamas. Bananas, pineapples, oranges, tomatoes and coconuts are all grown on the islands and form an important part of the local diet.

Right: The location map shows the position of the Bahamas island chain (marked in black).
Below: An underwater fisherman spearing a crayfish. These relatives of lobsters are an important Bahaman export.

lation of about 169,000. There are more than 1,000 islands in the group, but fewer than 30 are inhabited. Nassau, the capital of the Bahamas, is on New Providence Island.

A warm, sunny climate, white coral beaches and beautiful scenery have made the Bahamas one of the most popular tourist resorts. There are many brightly coloured birds and fish to be seen throughout the islands.

Although the tourist trade provides most of the income of the Bahamas, there are also some small industries. The most important industry is the production of salt. Wood pulp, tomatoes, cucumbers and crayfish are also exported.

In 1492, Christopher Columbus became the first European to reach the islands. It is thought that he landed at San Salvador Island.

A modern oil-loading terminal in Bahrain. Huge tankers call at Manama's deep-water port to carry oil from Bahrain and other Arabian countries all over the world.

Bahrain is an independent Arab sheikdom. It consists of a group of islands, by far the largest of which is also called Bahrain. This group of islands lies in the Gulf of Bahrain, between Qatar and Saudi Arabia. The total area of the sheikdom is 231 square miles. Bahrain Island itself is about 30 miles long and, at the most, 10 miles wide. Much of the island is desert and most of the sheikdom's 207,000 people live and work in towns. Manama, the capital and largest town, is also an important port. A causeway connects Manama to the island of Muharraq where Bahrain Airport is located. Bahrain Airport is the busiest airport in the Persian Gulf region.

Bahrain has important oil fields and large oil refineries.

Balboa, Vasco Núñez de (1475?-1519), was a Spanish explorer who crossed what is now the Isthmus of Panama and so became the first European to reach the Pacific Ocean from the Atlantic. With a party of about 200 Spaniards and 800 Indians, Balboa first sighted the Pacific on September 25, 1513. Four days later, the party reached the Pacific coast at the Gulf of San Miguel. Balboa named the sea the *Mar del Sur* (South Sea) and claimed it and its shores for Spain.

Balboa was born in Jerez de Los Caballeros, in western Spain. In the early 1500's, he settled on the island of Hispaniola (now Haiti and the Dominican Republic) as a farmer. Balboa soon got into debt. In 1510 he escaped his creditors by hiding in a cask on board a ship. The ship was taking soldiers to a colony on the Colombian coast. When they arrived, they found that Indians had driven away most of the colonists. Balboa suggested that the expedition should move to Panama, where they founded a settlement called Darien. Balboa took command of this settlement.

Indians told Balboa about the sea to the west. When he heard that the king was sending a new governor to Darien, Balboa set off to find the sea. Following his discovery, he was made governor of the South Sea and Coiba. His success was resented by Darien's new governor, who

Vasco Núñez de Balboa, a Spanish explorer, was the first European to reach the Pacific Ocean from the Atlantic Ocean. He arrived there in 1513.

The people of Bali, one of the islands of Indonesia, are famous for their graceful and intricate dances. These people are doing the Barong dance.

managed to have Balboa's governorship taken away. He also prevented Balboa from leaving Darien, and finally had him executed on a false charge of treason. He was publicly beheaded with four of his friends in the square at Acla.

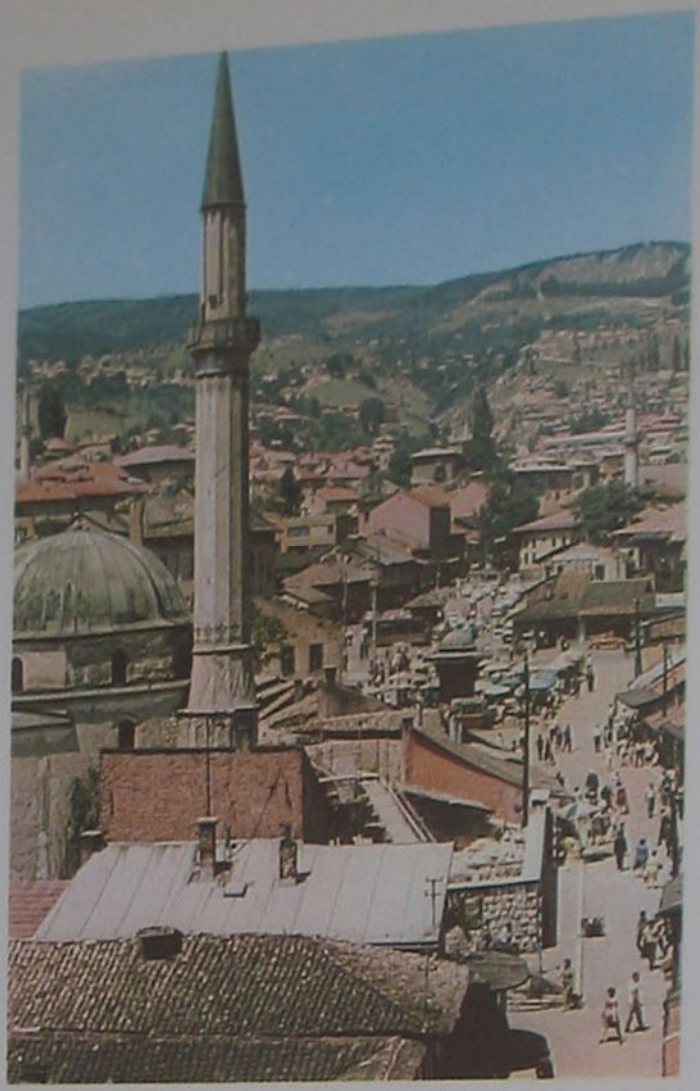
Balearic Islands are a group of Spanish islands in the Mediterranean, off the east coast of Spain. They consist of four main islands—Majorca (Mallorca), Minorca (Menorca), Ibiza (Iviza), and Formentera—and a number of smaller islands. The capital is Palma, on Majorca. The area of the islands is 1,935 square miles. The population is 443,327.

The Balearics have rugged coastlines and hilly surfaces. Agriculture and fishing are the traditional occupations of the people, and grapes, olives, figs, almonds, and oranges are important. But the mild climate, fine beaches, and varied scenery attract millions of tourists each year, and tourism is now the main industry. In the 1200's, after earlier invasions by many nations, the Balearics finally fell to Aragon (now in Spain).

Bali is a mountainous island of Indonesia, lying one mile to the east of Java. The island has an area of 2,147 square miles. Most of Bali's 1,782,529 people live in the capital, Singaraja.

Bali has a pleasant tropical climate and fertile soil. The chief products are copra, maize, fruits, vegetables, and rubber. Local handicrafts are also an important source of income. The Balinese are noted for their beauty and fine bodies. They are nearly all Hindus, and are skilled musicians and dancers.

The island was settled by explorers from India in the 600's A.D. In the following centuries many Javanese came to Bali. The Dutch established complete



This *minaret* (prayer tower) in Yugoslavia is a reminder of centuries of Turkish rule in the Balkans.

control from 1908 to 1949, when the island gained independence as part of Indonesia.

Balkans is the name given to six countries in south-eastern Europe. They are Albania, Bulgaria, Greece, Rumania, Turkey and Yugoslavia. Only part of Turkey is in Europe. The rest is in Asia.

Together the six countries form the Balkan Peninsula. The peninsula is bounded on the west by the Adriatic Sea and the Ionian Sea, and on the east by the Black Sea and the Aegean Sea.

Mountain ranges cover much of the Western part of the Balkans. The peninsula is named after one range, the Balkan Mountains. To the north and east, in Bulgaria and Rumania, the land is a fertile plain, through which the great River Danube flows to the Black Sea.

Turkey ruled much of the area for 500 years until the 1800's, when the other countries won independence.

Ball is an object, generally round, used in various games and sports. According to the game being played, the ball may be thrown, kicked, hit, pushed, rolled, or carried. Balls vary in size from 1½ inches to 6 feet across.

Although nearly all balls are *spherical* (shaped like a globe), there are some notable exceptions. The rugby ball is *oval*, or egg-shaped. The American football is similar, but slimmer and more pointed. The ball used in lawn bowls is built with one side larger than the other, causing it to roll in a curve.

Balls may be hard or soft. They may be solid or inflated with air. Originally they were made of natural materials such as wood, leather, and animal hair. But today, increasing use is being made of artificial materials such as plastics.

Ballet is an entertainment danced to music. It may tell a story or create a mood, or it may bring out the meaning of the music only through the movement of the dancers.

Several people help to make a ballet. The *composer* works together with the *choreographer* who thinks up the complete movements of the dancers. Sometimes a choreographer sets a ballet to music already written. He also rehearses with the *dancers* to teach them the movements. Meanwhile the *designer* creates ideas for the stage setting, dresses, and lighting. The scenery has then to be built, dresses made, and the orchestra rehearsed before the ballet is finally performed.

People have danced to entertain themselves and others for thousands of years. In about 1400, French and Italian lords and ladies began to produce danced entertainments at court. By the mid-1600s, at the court of Louis XIV of France, these entertainments had become so magnifi-

cent that only professional dancers could dance them. The dances then moved from the court to theatres, and women began to dance professionally.

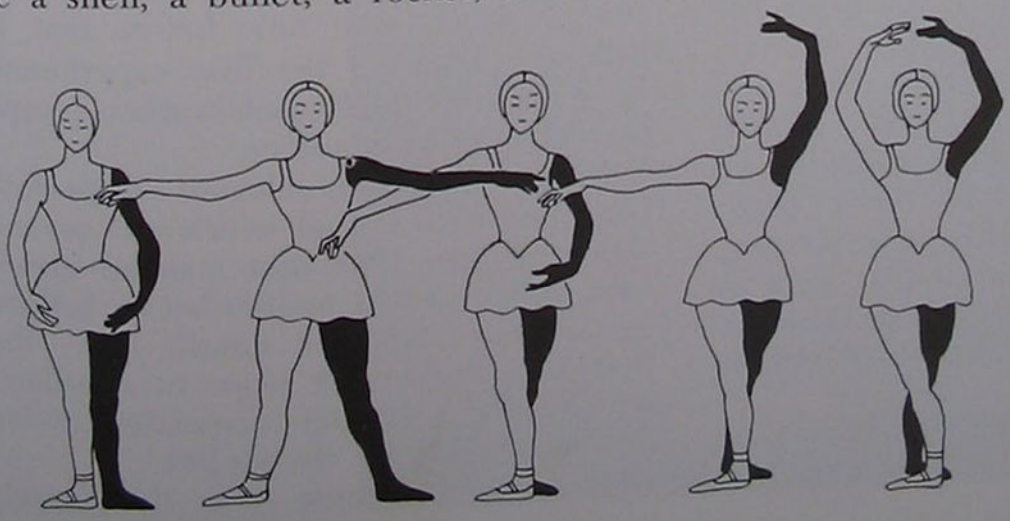
Ballet as we know it today soon came into being. In the early 1800s, people in France and Italy flocked to see *romantic* ballets, such as *La Fille Mal Gardée, Giselle,* and *Coppélia.* These ballets usually told a story and were noted for the elaborate dancing and the white, billowing skirts of the women dancers. By the late 1800s, the ballet had developed into a great art, especially in Russia. This period of ballet, *classical* ballet, was known for its grand *corps de ballet* (company or cast), the perfection of the dancing, and the close link between music and dance. Classical ballets include *Swan Lake* and the *Sleeping Beauty.* In modern times, choreographers have concerned themselves more with *abstract* ballet, in which there is little or no story.

The most famous of ballet companies was the *Ballet Russe,* formed in 1909 by the Russian impressario Sergei Diaghilev. This company created many important ballets, particularly those composed by Stravinsky, such as *Petrouchka.* The best known of today's companies are the Bolshoi Ballet, in Moscow, London's Royal Ballet Company, and the New York Ballet Company.

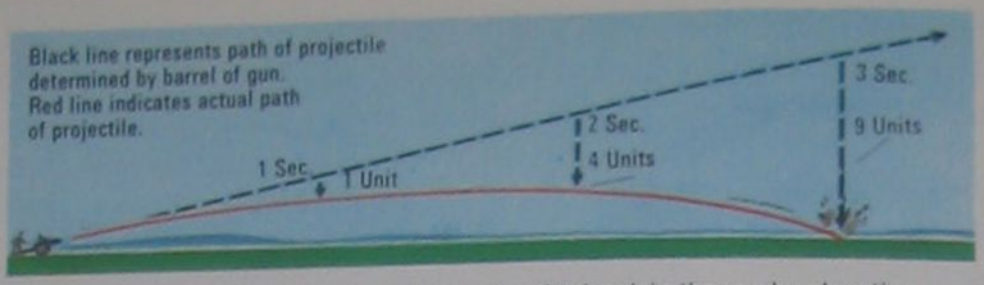
Ballistics is the science that studies the movement of projectiles. A projectile may be a shell, a bullet, a rocket, an arrow or even a golf ball—anything that is hurled through the air. Ballistics is used in the design of guns, missiles and propellent explosives. It also concerns the aiming of guns and rockets. These two divisions are called *interior ballistics* and *exterior ballistics.* The path of a projectile is called its *trajectory.*

When a gun is fired, the pressure of expanding hot gases from the explosion forces the bullet or shell out of the barrel. The distance the shell travels depends mainly on the weight of the shell and the force of the explosion. This, in turn, depends on the diameter of the barrel, called its *calibre.*

For a shell or bullet to travel true and reach the target nose first, it must spin on its axis. Rifling inside the barrel—long spiral grooves—makes it do this. As

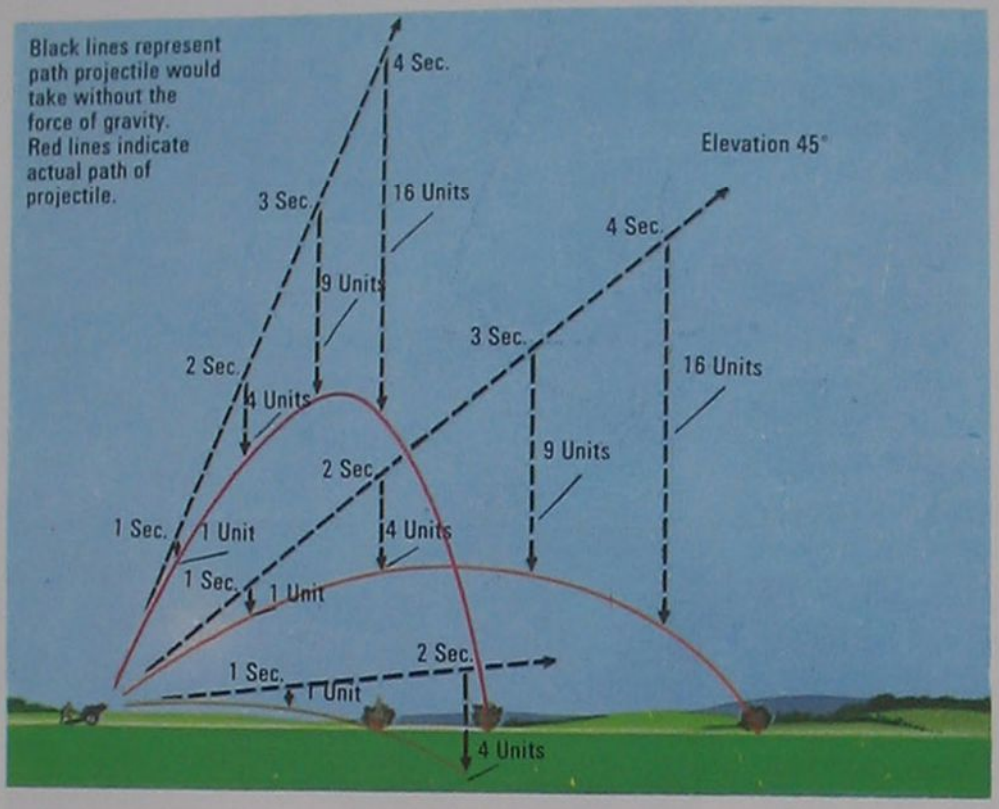


Above: The Waltz of the Flowers from Act II of *The Nutcracker* by Tchaikovsky.
Left: In 1661 Louis XIV founded a Royal Academy of Dancing, which devised rules for the correct steps for ballet based on five main positions of the feet. Today, with a few small changes, they are still the basis of classical ballet, for they were planned to give a balance to any position of the body.

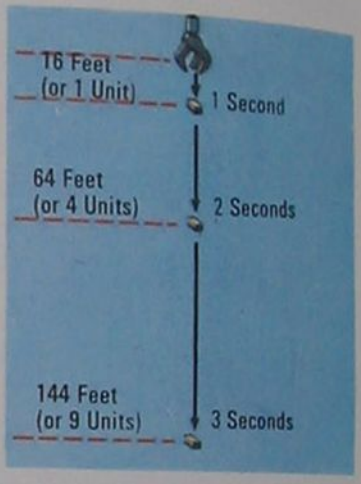


Top left: If a line representing the path a projectile would take without gravity is plotted against the distance it actually falls each second, a curve can be drawn joining the points which will represent the projectile's path.

Bottom left: The maximum range of a gun is obtained, in theory, by elevating the barrel to an angle of 45° above the horizontal. In practice the angle might be slightly greater.



Bottom right: The diagram illustrates one of the basic principles of ballistics, that a free falling object increases its speed at a constant rate, neglecting air resistance.



soon as a shell leaves a gun barrel, the force of gravity starts to pull it downwards towards the ground. For maximum range, the gun barrel must be pointed upwards at an angle of 45°. At steeper angles, the shell travels higher but not as far. At lower angles, the shell does not climb as high and does not go as far. Using laws about gravity first worked out more than 300 years ago by the great Italian scientist Galileo, we can calculate the range of a shell if we know its velocity and the firing angle. In theory, the trajectory is a curved path known as a *parabola*. But in practice the path is altered by air resistance, and gun sights and range tables have to take this into account. Large modern guns are aimed using radar and electronic computers.

At very high speeds, projectiles can do remarkable things. For example the force of a tornado may be sufficient to 'fire' a piece of straw right through a plank of wood. These situations are studied in *terminal ballistics*.

Balloons and airships Modern aircraft developed from the Wright brothers' flimsy flying machine of 1903. But men were flying a long time before that, in balloons. Some of the first experiments were made by the French brothers Joseph and Etienne Montgolfier.

In June 1783, they released a huge cloth bag filled with hot air which rose several thousand feet. The first manned ascent took place in a Montgolfier hot-air balloon in October 1783. A month later, the first free flight took place in a balloon which had a brazier suspended under the air bag to keep the air hot.

At about the same time, the French

Modern ballooning at Muerren in the Swiss Alps.

On May 6, 1937, the Zeppelin Hindenburg exploded at Lakehurst, New Jersey, U.S.A., with the loss of 36 lives. This was one of a series of disasters that ended the use of passenger-carrying airships.

scientist J. A. C. Charles was experimenting with balloons filled with the very light gas hydrogen. And in December 1783 he made a successful first flight.

Hydrogen balloons proved to be much better than hot-air ones, and Charles' design was a model for later balloons. The passenger car, or *gondola*, was suspended from a net thrown over the balloon to distribute the weight evenly. There was a hand-operated valve in the balloon to let the gas out when passengers wanted to descend. Bags of stones were taken in the car to be used as ballast. They could be thrown out to make the balloon rise higher.

In 1794, the French used balloons for observation in their war against Austria. From then on, balloons were widely used for this purpose up until the First World War (1914-18). In the Second World War (1939-45) tethered barrage balloons were used against low-flying aircraft.

Ballooning was a popular sport right up until the 1930's, and even today there are many keen balloonists. But the greatest present-day uses of balloons are in weather forecasting and scientific research. Such balloons are called *radiosondes*, because they radio back information about the atmosphere. Most balloons used today contain helium, which is not inflammable like hydrogen.

The drawback with balloons is that they can only go where the wind blows them. So people began to consider ways of powering them. In 1852, a Frenchman, Henri Giffard, built a cigar-shaped balloon with propellers driven by a steam engine. This was the forerunner of the *dirigible* (steerable) balloon, or *airship*.

Many designs followed, and in the 1890's petrol engines provided them with a new, lightweight source of power. In 1897, an Austrian, David Schwarz, designed a rigid airship in which the outer, gas-tight skin was supported by a framework. It crashed.

One of the spectators was the German Count Ferdinand Zeppelin, who soon began to build his own rigid airships. In 1900, he launched the first one which was 420 feet long. Soon his airships were in regular use for carrying passengers and mail.

The Americans and the British built airships, too, mostly based on the design of the Zeppelins. The British R-34 made the first Atlantic crossing in 1919. In the 1930's, a series of disasters showed how dangerous airships were, and airship development ceased.

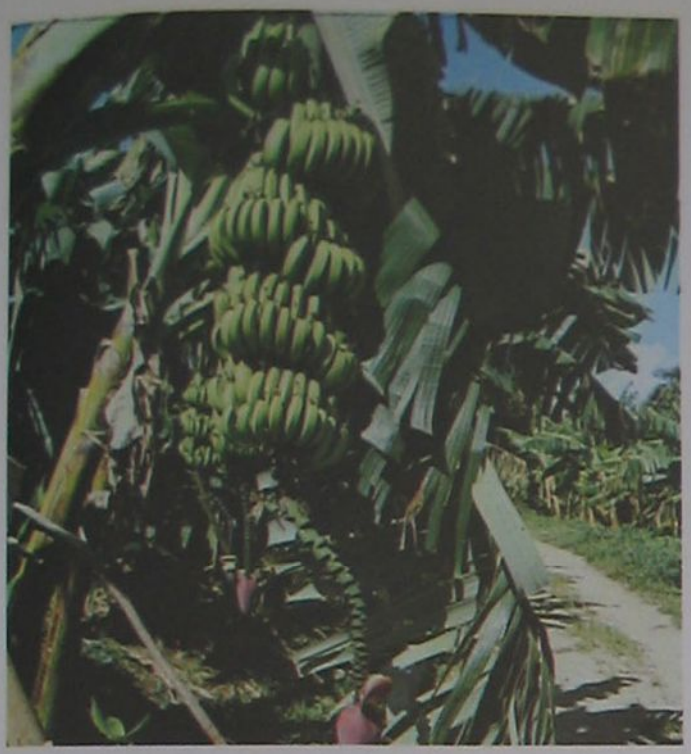
The Baltic is almost entirely enclosed by land.

Baltic The Baltic is a large sea in northern Europe. Two narrow straits, the Kattegat and the Skagerrak, together form a channel linking the Baltic to the North Sea.

The Baltic Sea covers an area of about 160,000 square miles. It is an important seaway. Finland, Germany, Poland, Russia and Sweden border the sea.

Bamboo is a woody plant of the grass family that grows like a tree. The plants are found in tropical and semi-tropical regions, and some may reach a height of 120 feet. The tough stems are hollow and jointed, and have a variety of uses. They are used in building and furniture-making. The young shoots are a popular food in the East.

Engineers have tested laminated *(layered) bamboo and have found that its breaking point is nearly as great as that of soft steel.*



Bananas, which grow upwards, are picked while green so that they are not overripe when they reach the shops.

Bananas are a popular fruit with a yellow skin. They originated in South-East Asia and are now growing in many tropical countries. In Central and South America, bananas are grown for export to temperate countries. The banana plant also provides leaves and fibres useful for making roofing, mats and baskets.

The banana plant usually grows to a height of 15 to 20 feet. Although it looks like a tree, it is not a tree, because its trunk consists of leaf stalks growing close together and not of wood. The bananas grow in large, cone-shaped bunches hanging below the large leaves. There may be one hundred or more bananas in each bunch, but only one bunch on each trunk. The fruit is usually picked while still green and left to ripen during the journey to markets in other countries. If they are still unripe when they arrive, the bananas may be ripened artificially.

Bananas consist of about three-quarters water and almost one-quarter sugar and starch, with a little fat and protein. They are usually eaten raw, but can be fried or baked and served with cream.

Banffshire, a county in north-eastern Scotland, has a 30-mile coastline on the Moray Firth in the north. The southern part of the county is in the Highlands. Banffshire's county town is Banff, and its area is 630 square miles.

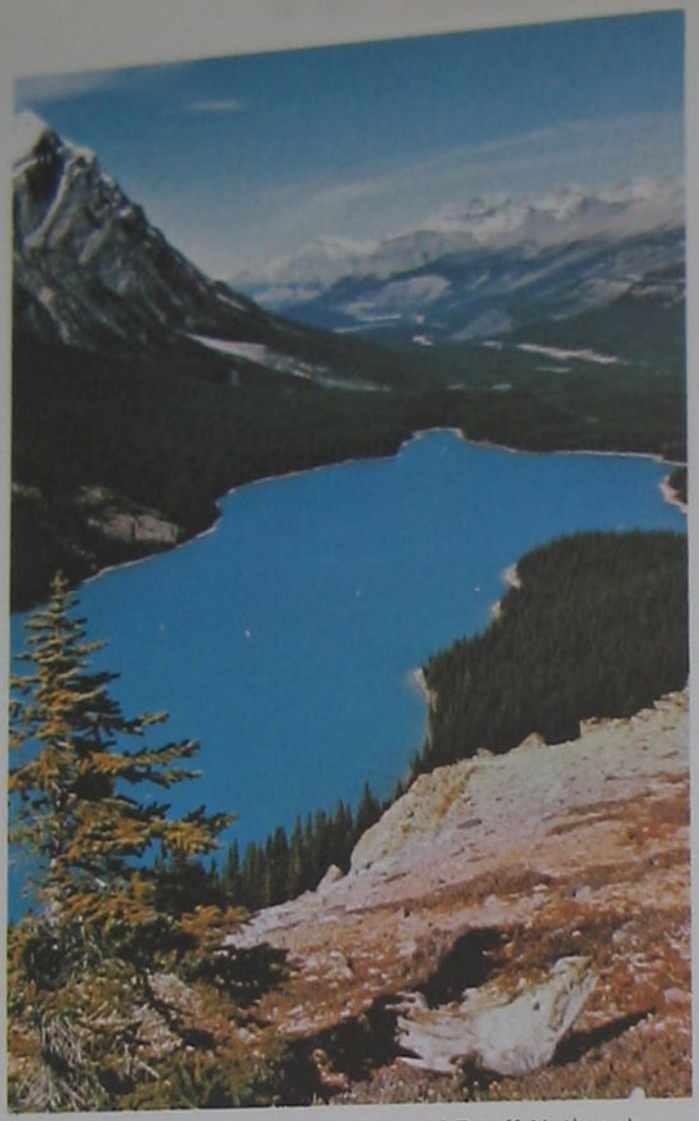
The coastal area, with its many small fishing ports, is the most thickly populated part of the county. Inland from the coast there are fertile farmlands, where oats, barley, and other crops are grown. There is also good farming land near the River Spey (which forms part of the county's western boundary) and in other river valleys. There are numerous whisky distilleries.

Farmers in the hilly areas of the centre and south raise cattle and sheep. Much of this part of Banffshire is heavily forested. The Highlands are popular with anglers, deer-stalkers, and other sportsmen. Ben Macdui, in the Cairngorm mountains at the extreme south of the county, rises to 4,296 feet, and the Cairngorm peak to 4,084 feet.

Banff National Park was Canada's first national park and was established in 1885. It lies in a magnificent mountainous region in south-west Alberta. The Trans-Canada Highway runs through the park, and it is within easy reach of several cities.

The resorts of Banff and Lake Louise are situated in the south-eastern part of the park on the slopes of the Rocky Mountains. Both resorts and the surrounding national park are major tourist attractions. Covering an area of more than 2,500 square miles, the park includes some of the finest mountain scenery in Canada. In some places the mountains rise to heights of more than 10,000 feet above sea level. Some of the highest mountains in the Canadian Rockies are found in the park. There are also many beautiful lakes and several kinds of animals. Bears, mountain goats, sheep and deer roam the park. They are protected by law.

Hot sulphur springs were discovered just before the park was established and



The magnificent mountain scenery of Banff National Park attracts many thousands of visitors each year.

many visitors come to bathe in the pools. Mountain climbing, skiing and swimming all help to attract tourists to the area.

Bangla Desh is a country of southern Asia, on the Bay of Bengal. Its land borders are all with India, except for a short border with Burma in the south-east. Until 1971, Bangla Desh was part of Pakistan, but in that year it was declared independent. Its capital is Dacca. Its area is 55,638 square miles, and its population about 70 million.

Most of Bangla Desh is flat and low-lying. It is watered by two great rivers, the Ganges and the Brahmaputra, and their numerous tributaries. In the south, the Ganges and the Brahmaputra join to form a vast delta, and many river mouths —the 'mouths of the Ganges'—empty their waters to the sea.

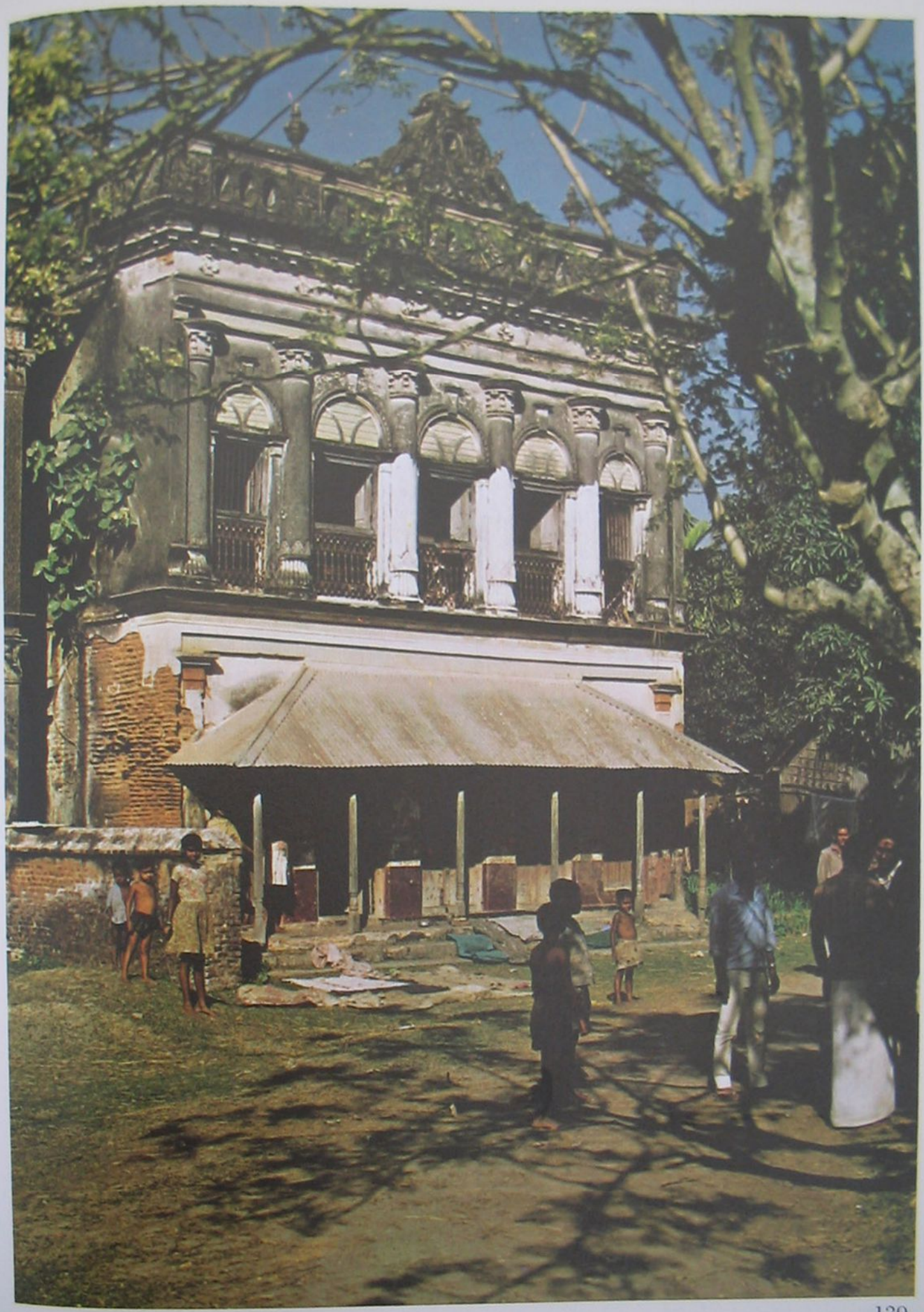
This location map shows the position of Bangla Desh (in black).

The chief crop of Bangla Desh is rice, which is the staple food of the people. Tea and jute are economically very important because they are the main exports. The climate is hot and damp, and during the summer the country experiences the monsoon, when the rainfall is so heavy that many places are almost impassable. Disasters are frequent. In 1970 a cyclone and flood caused more than half a million deaths in the delta area.

Most of the people of Bangla Desh are Muslims. They speak Bengali, and some also understand English. The most important city, after Dacca, is Chittagong, which has a busy port. There are few roads, but more than 4,500 miles of rivers and canals provide communication between towns and villages.

Until British rule ended in 1947, the region that is now Bangla Desh was part of Bengal. It then became East Pakistan, separated from West Pakistan by almost 1,000 miles of Indian territory. Resentment at what was felt to be the unfair dominance of West Pakistan led to rebellion and the arrest of the Eastern political leader, Sheikh Mujibur Rahman. In the disorders that followed, millions of refugees from East Pakistan fled to India. Eventually, Indian forces intervened, and with their aid the independent Republic of Bangla Desh came into being in 1971. Sheikh Mujibur Rahman became the first president.

Right: A crumbling western-style house stands in a village in Bangla Desh. In the early 1970's the country, formerly East Pakistan, was the scene of a terrible war for independence.



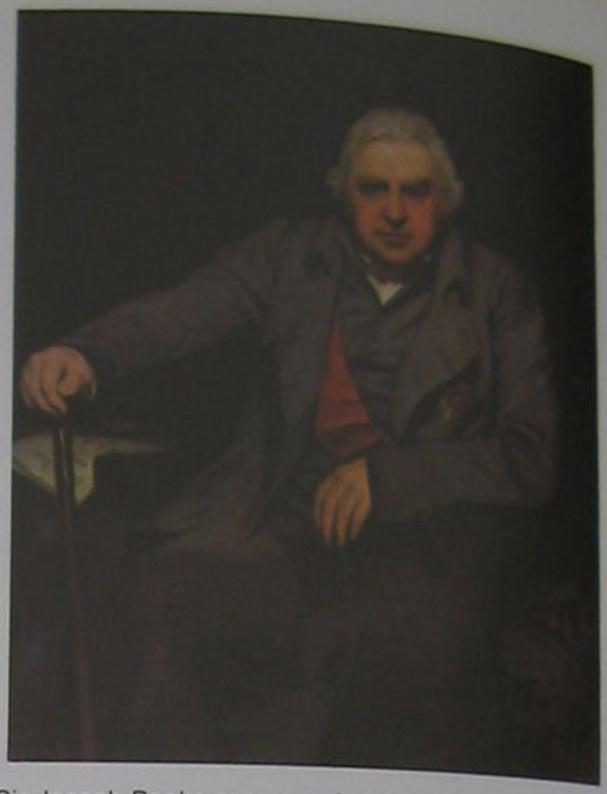
Banking Banks take care of people's money, and use it to earn more money. They do this by lending it to people who want to borrow money and by charging interest on the loan. By receiving money from those who can spare it and lending it to those who can make use of it, banks play a very important part in the economic affairs of a country. There are three main kinds of banks: commercial banks, saving banks, and central banks.

Commercial banks are the banks that we can see in the High Street of any small town or in many places in large cities like London, Glasgow, or New York. People deposit their savings and their wages in such banks, and the banks help them by taking care of their money, by making it easy for them to pay bills, and by giving them advice. A person who has an *account* with a bank (that is, who has placed money in the bank) does not have to carry his money around with him and can withdraw money from his account whenever he needs it. Most banks offer two kinds of accounts: current accounts and deposit accounts. A customer who has a *current account* can withdraw money from his account at any time during the business hours of the bank. A person who has a *deposit account* must give the bank a little notice before withdrawing money from it.

Other types of commercial banks are merchant banks and finance companies. These banks specialize in financing business companies.

Savings banks, such as the Post Office Savings Bank, accept deposits of money from the public and pay interest on it. They do not lend money, and they do not make any profit. Their purpose is to encourage people to save.

Central banks, such as the Bank of England, carry out banking business for the government and also do business for other banks. They help the government to control the country's financial affairs. They also issue currency, by authority of the government.



Sir Joseph Banks accompanied James Cook on his voyage round the world from 1768 to 1771. He helped in the development of New South Wales.

Banks, Sir Joseph (1743-1820), was an English *naturalist* (a person who makes a study of animals and plants) who sailed round the world with James Cook from 1768 to 1771. Before sailing, he spent a huge sum of money turning their ship, the *Endeavour*, into a floating laboratory. During his explorations, particularly of Australia, he discovered hundreds of new plants and made a large collection of specimens. During that time he also played an important part in the development of New South Wales, urging the British government to start a settlement at Botany Bay and giving advice during its early years.

Banks was one of the principal founders of the Botanical Gardens at Kew, near London. He helped to introduce new plants and foods to different parts of the world. In 1778 he was elected president of the Royal Society.

Bannockburn in Stirlingshire, Scotland is famous for the battle fought nearby on June 24, 1341. A Scottish army under Robert Bruce was attacked by a larger English force under Edward II. The

Sonia Halliday

A Greek Orthodox priest holds up a newly baptized child. In some Christian Churches children are completely dipped in water; in others, a few drops of water are poured on the baby's head.

English were heavily defeated, and this victory paved the way for Scottish independence.

Bantu is the name of a large group of related languages spoken in Africa and also the name given to the various Negro tribes who speak these languages, including the Zulu, Swazi, Mashona and Matabele.

There are approximately 50,000,000 Bantu-speaking people. They inhabit the vast central and southern region of the continent, extending from the Congo and Zaïre to parts of South-West Africa, Botswana and South Africa.

Bantu people originally migrated from northern regions into central Africa, and from there spread southward, mixing with the native Hottentots and Bushmen. As a result, they show wide differences in appearance. Their ways of life also differ. Some are cattle herders, others are farmers; some are peaceful, others more warlike. Certain groups, such as the Buganda in what is now Uganda, were once organized into large kingdoms headed by powerful chiefs. In the 19th century other groups joined together in confederations to resist European colonization.

There are more than 100 Bantu dialects, the best-known of which is Swahili. In the Bantu languages the word 'Bantu' means 'people'.

Baptism is a religious rite or ceremony in which water is poured over a person as an outward sign that he has been accepted into the Christian community and that he is fresh and clean in spirit.

In the New Testament Jesus instructed his followers: 'Go therefore and make disciples of all nations, baptizing them in the name of the Father and of the Son and of the Holy Spirit.'

Most Christian Churches today practise infant baptism. The most usual way

of baptizing is to pour water over the head. Some Churches, particularly the Baptists, still practise total immersion (plunging the whole body in water).

Barbarian invasions The groups of tribal peoples living on the fringes of the Roman Empire around the 5th century included Huns, Vandals, Visigoths, Ostrogoths, Franks and Saxons. Occasionally, members of these groups settled peacefully within Roman boundaries; at other times, they attacked and occupied Roman territory. The Barbarian invasions, as these movements were known, contributed to the weakening and eventual fall of the Empire.

The Huns, a wandering tribe from Mongolia, were the fiercest of the Barbarians. As hordes of Huns moved out of Asia, they threatened other tribes in their path, and caused them to flee towards the Roman lands.

The Visigoths, a Germanic people, were forced by the Huns across the River Danube in 376. At first, they established themselves as an independent nation within the Empire, but in 410, under their leader Alaric, they invaded Italy. Ten years later they took Rome.

This map shows how the Barbarian tribes had settled in Europe by the 5th century A.D.

The Vandals, another Germanic tribe living in central Europe, were also forced westwards by the Huns during the 4th and 5th centuries. They attacked Gaul (now France) and Spain, eventually reaching North Africa. Under their leader, Genseric, they captured Rome in 455.

Meanwhile, the Huns themselves were moving into Europe. They conquered the Ostrogoths, and then, under Attila, attacked Gaul in 451 and northern Italy in 452. But after Attila's death in 453, the power of the Huns waned. The Ostrogoths re-established themselves, and in turn, conquered Italy in 493.

In the north-west, another important group, the Franks, occupied the Rhine region. They were allies of the Romans, and eventually they established the Frankish Empire in Gaul.

Barcelona is the second largest city in Spain, and the country's main seaport and industrial centre. Founded in the third century B.C., it stands on the Mediterranean coast of north-eastern Spain, about 3 miles north of the mouth of the River Llobregat. Barcelona has a population of 1,750,000. It has important textile, engineering and chemical industries.

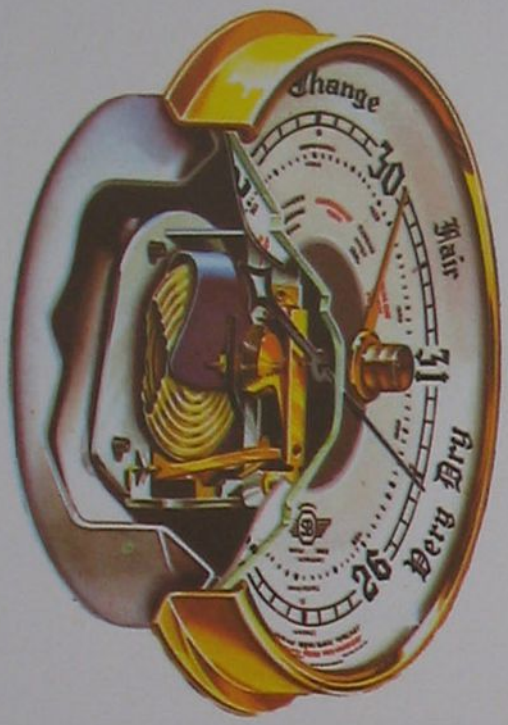
Barometer Because air has weight it exerts a pressure. The weight of air at the 'top' of the atmosphere presses down on the lower layers of the air. The barometer is an instrument that measures this air pressure. At sea level, air pressure averages about 15 pounds on every square inch.

Barometers are used by weather forecasters to measure air pressure. As a general rule, falling air pressure means stormy weather, and rising pressure means more settled weather. There are two main types of barometers, *mercury* barometers and *aneroid* barometers.

The mercury barometer is simply a column of mercury enclosed in a glass tube. It works on the principle that normal air pressure supports a certain amount

of mercury in a tube out of which the air has been drawn. This amount (about 30 inches or 76 cms) varies with changes in pressure. When there is a decrease in air pressure, the column falls. When there is an increase, the column rises.

The aneroid barometer is the type often seen in homes. It works on a different principle from the mercury barometer. It contains a small metal box from which most of the air has been drawn. The box has a flexible lid to which a lever is attached. Changes in air pressure move the lid and its lever. The lever is connected to a pointer, which it moves across a dial to indicate air pressure.



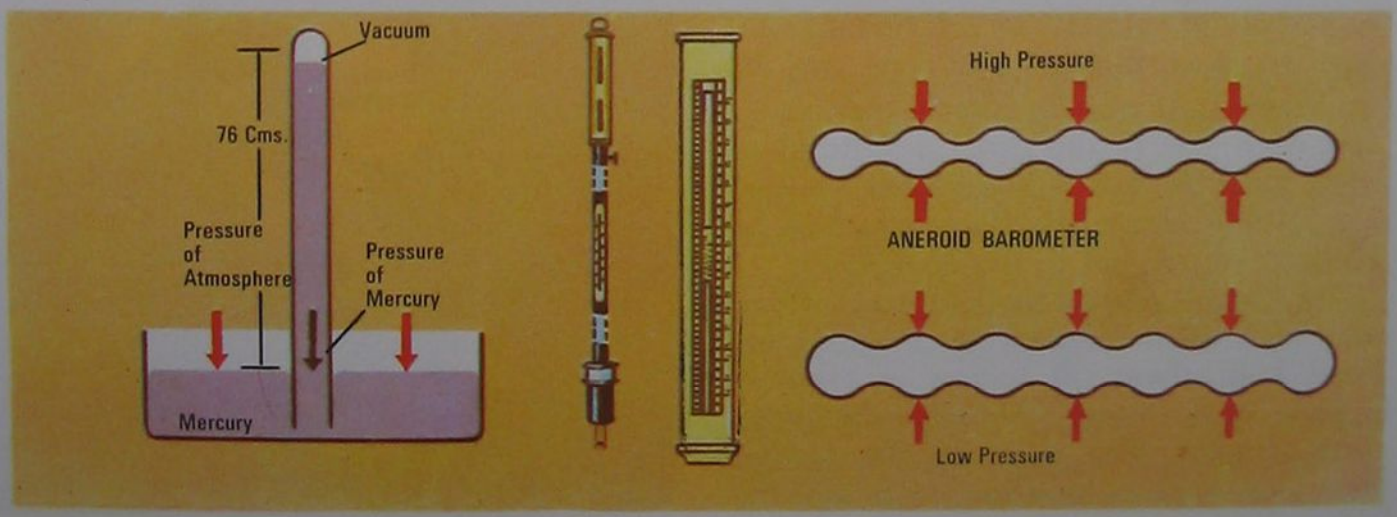
Above: Cut-away drawing of a domestic barometer.

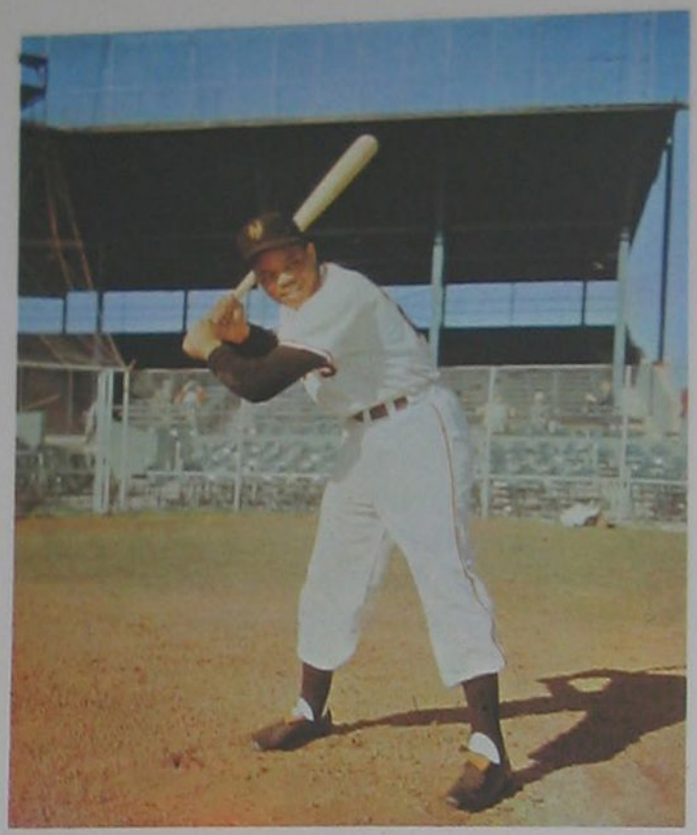
Below: The mercury barometer (left) works by measuring the height of a column of mercury supported by the pressure of the atmosphere. The aneroid barometer measures the pressure of the atmosphere on a partly evacuated thin-walled metal box. The domestic barometer shown above is of this type.

Baseball is played by two teams of nine players, on a large field on which is marked a diamond, 90 feet square. The ball has a hide covering, weighs about 5 ounces and is about 9 inches in circumference. The wooden bat is a round, tapering club, with a length of 42 inches.

Bases are placed at the corners of the diamond, and fielders are distributed in recognised positions. The 'pitcher' stands on a raised mound in the centre of the diamond, while the 'catcher', protected by mask, chest protector and padded mitt, stands behind the batsman on the 'home plate'.

The pitcher throws the ball overhand, underhand, or sidearm, towards the catcher. A 'fair throw' is one directly over the home plate and roughly between the batsman's shoulders and his knees. The batsman attempts to hit the ball forward into 'fair territory'. If he succeeds, he runs as far as possible round the diamond, stopping at one of the bases before the fielder standing there gains possession of the ball. If he reaches home base he scores a run. A batter is declared out if he fails to strike after three attempts, is fairly caught out by a fielder, or is tagged by a fielder while between bases. After





Baseball. The batting stance. The game was originally evolved from cricket and the English sport of rounders.

receiving four unfair balls, however, the batter is awarded a base. An innings is closed when three batsmen are put out, and there are nine innings to a game.

The team that scores most runs at the end of nine innings wins the game. If there is a tie, play continues until the tie is broken.

The basic rules of baseball were developed between 1845 and 1876, when the National League was founded in America. Since then there has been little change.

Basketball is played on a rectangular court no more than 94 feet long and 50 feet wide. It is usually played indoors.

At each end of the court a bottomless string mesh basket is hung from a metal ring 10 feet above the floor, attached to a board set parallel to the back line.

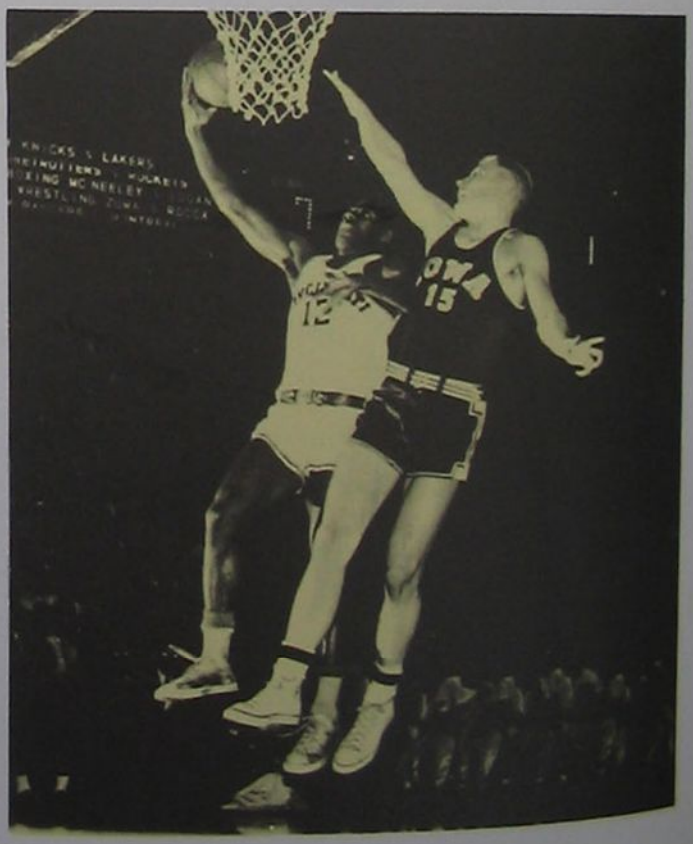
The game is played by two teams of five men each who manoeuvre a round inflated ball, about 30 inches in circumference, so as to toss it through the opponents' basket. The ball may be passed from one man to another, or it may be dribbled, or bounced along the floor by any single player. Running or walking with the ball is illegal.

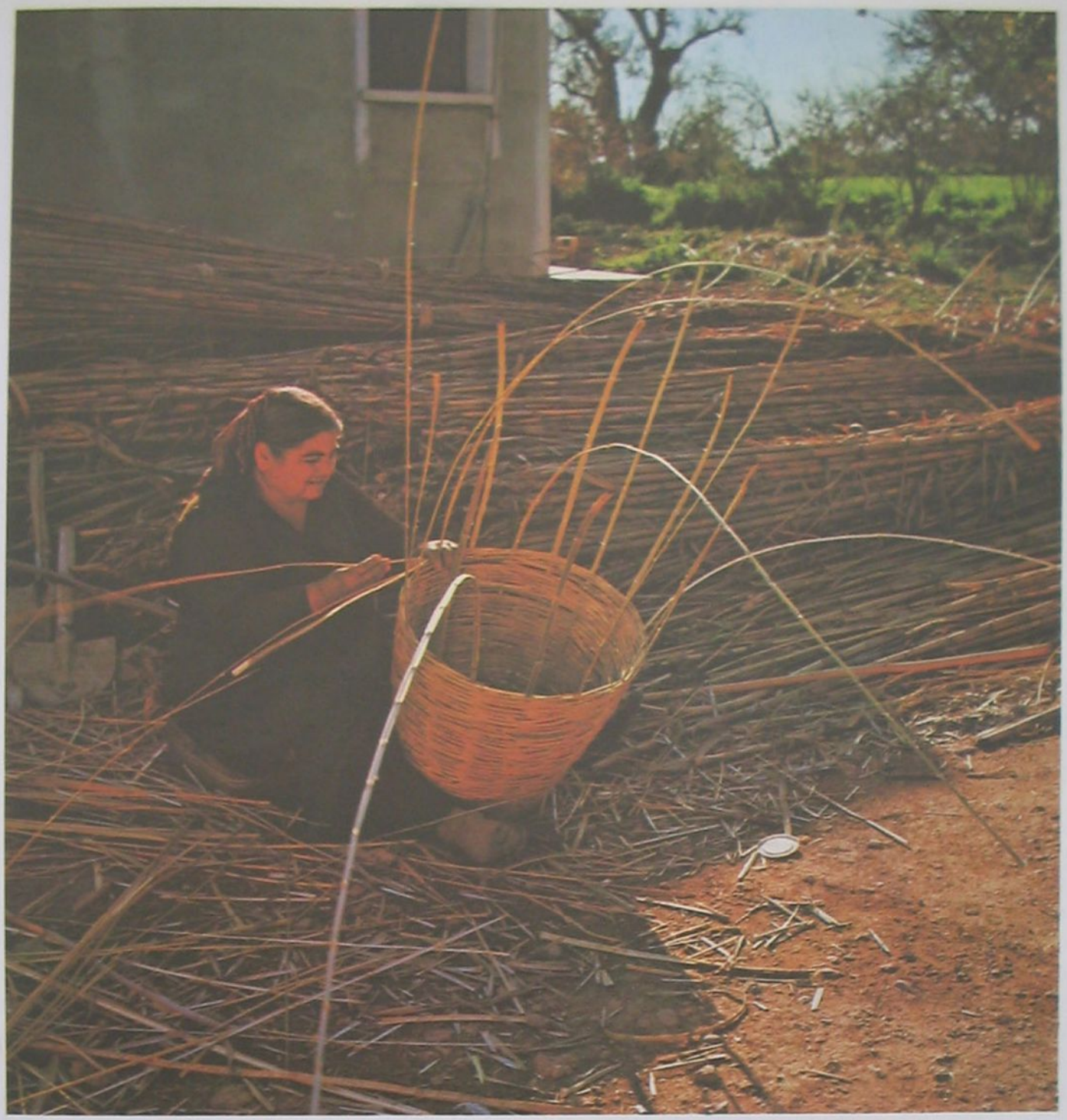
A player dribbling the ball may not charge into an opposing player, and his opponents may not impede his progress by any form of personal contact. When there is personal contact, the referee calls a foul on the offending player.

In most cases a player who is fouled is given one or two free shots at the opponents' basket from a line 15 feet in front of the backboard. His team is awarded one point for each foul shot through the basket. Field goals – legal shots through the basket during the course of play – earn two points. Professional basketball games consist of four 12-minute quarters.

Basketball was invented by James A. Naismith, a Y.M.C.A. official, and first played at Springfield, Massachusetts, in 1891. It was almost exclusively an American game until 1936, when it was introduced to the Berlin Olympics. Since then it has gained enormously in popularity.

A player about to score a jump shot in a college basketball game at Madison Square Garden, New York.





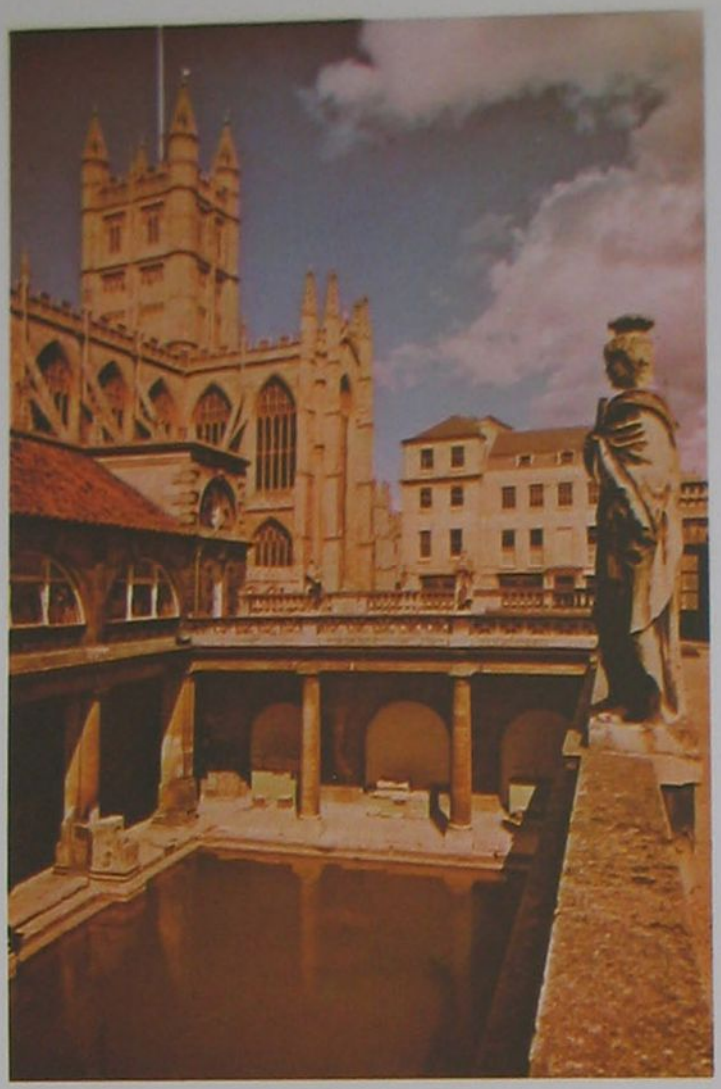
Sonia Halliday

A Cypriot woman weaves a basket. The canes are soaked in water to make them pliable.

Baskets are woven containers made of such materials as reeds, straw, cane, raffia, bamboo or grass. These materials are strong and light and can be woven into various shapes for mats, bags and hats, as well as baskets. Some primitive peoples also use them for building houses, boats, coffins and animal traps.

People have used the same methods of basket-making since prehistoric times. One method is to make a stiff framework in the form of rods or spokes, and then weave a lighter material in and out of the spokes. The lighter material is often soaked in water to make it pliable. Another method is to coil the straw or cane into the required shape, and secure the coils with thinner material.

Baths are tubs or pools of water in which people immerse themselves for washing, for the sake of their health, or for swim-



Left: A Roman bath at Bath, famous for the healing properties of its mineral-bearing waters. Above: An ornate Victorian bath, with a complicated spray shower at its head.

ming and recreation. In many countries, people have bathrooms in their houses. Cities have public buildings where people can bathe.

Public baths have existed since ancient times. The Romans built huge, magnificent structures for bathing, complete with heating systems beneath the floors. Bathers could take advantage of hot, cold, and tepid water, steam rooms and oil rubs.

In a Finnish sauna people sit and sweat in a very hot, dry room, and then plunge in cold water or snow. Turkish baths have a series of rooms at various temperatures, some very hot and steamy. Many people visit *spas* (resorts with mineral springs) to drink the water or to bathe in it. And bathing is used to help disabled people to strengthen their muscles.

Bathyscaphe is a self-contained diving craft used for exploring the ocean bottom at great depths. It has no links with the surface. The bathyscaphe was designed by a Swiss scientist, Auguste Piccard, and made its first dive in 1948.

Having once been a balloonist, Piccard applied similar principles to the design of his underwater craft. The crew and instruments are within a heavy steel sphere, and are protected from the immense pressure. The sphere hangs from a large cylindrical float containing petrol, which is lighter than water. The craft is manoeuvred up and down by taking on water or releasing some of its heavy iron ballast. It is driven horizontally by a motor and propellers.

Bats are the only mammals that fly. They have small furry bodies, rather like those of mice, and broad, thin wings. Their

In 1960, Piccard's son Jacques and Donald Walsh took the bathyscaphe Trieste *to a record depth of over six miles in the Pacific Ocean.*

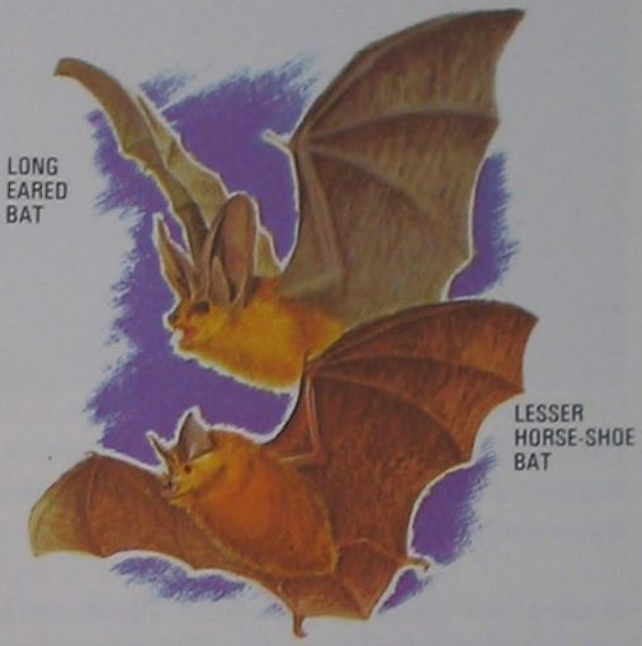
wings consist of *membranes* (sheets) of skin extending from the sides of the body and supported by the back legs and the extremely long 'fingers' of the front legs. Bats fly by reaching forwards and scooping air backwards and downwards.

There are nearly a thousand *species* (kinds) of bats, spread through most of the world. The two main groups are the *insect-eating bats* and the generally larger *fruit-eating bats*. The vampire is an 'insect-eater' that in fact feeds entirely on the blood of other animals.

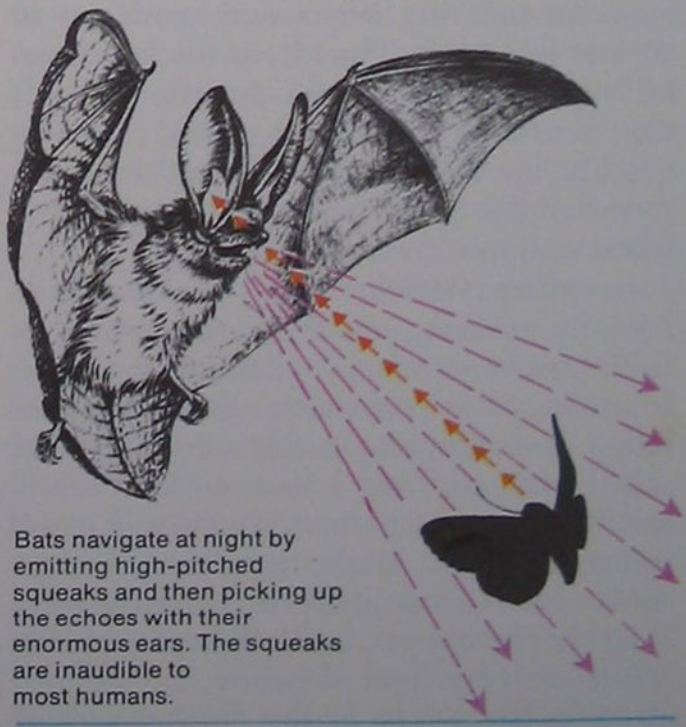
The fruit-eaters, also called flying foxes, have good eyesight, and generally fly at dusk. Insect-eaters, on the other hand, have very poor eyes. Yet they can fly in pitch darkness, finding their way with a kind of echo-sounding system so accurate that they can use it to catch insects in flight. The bat lets out a series of extremely high-pitched squeaks and listens for the echoes bounced back by objects in its path.

Bats generally spend the day hanging upside-down in caves, trees, or buildings. Some caves contain millions of bats. In cool regions they spend the winter hibernating in this way (see Hibernation).

Many bats hibernate during the winter, hanging upside down. Perhaps their low metabolic rate during hibernation accounts for their unexpectedly long life-span (they can live for up to about 15 years).



The long-eared bat emits vibrations through its mouth, the lesser horse-shoe bat through its nose.

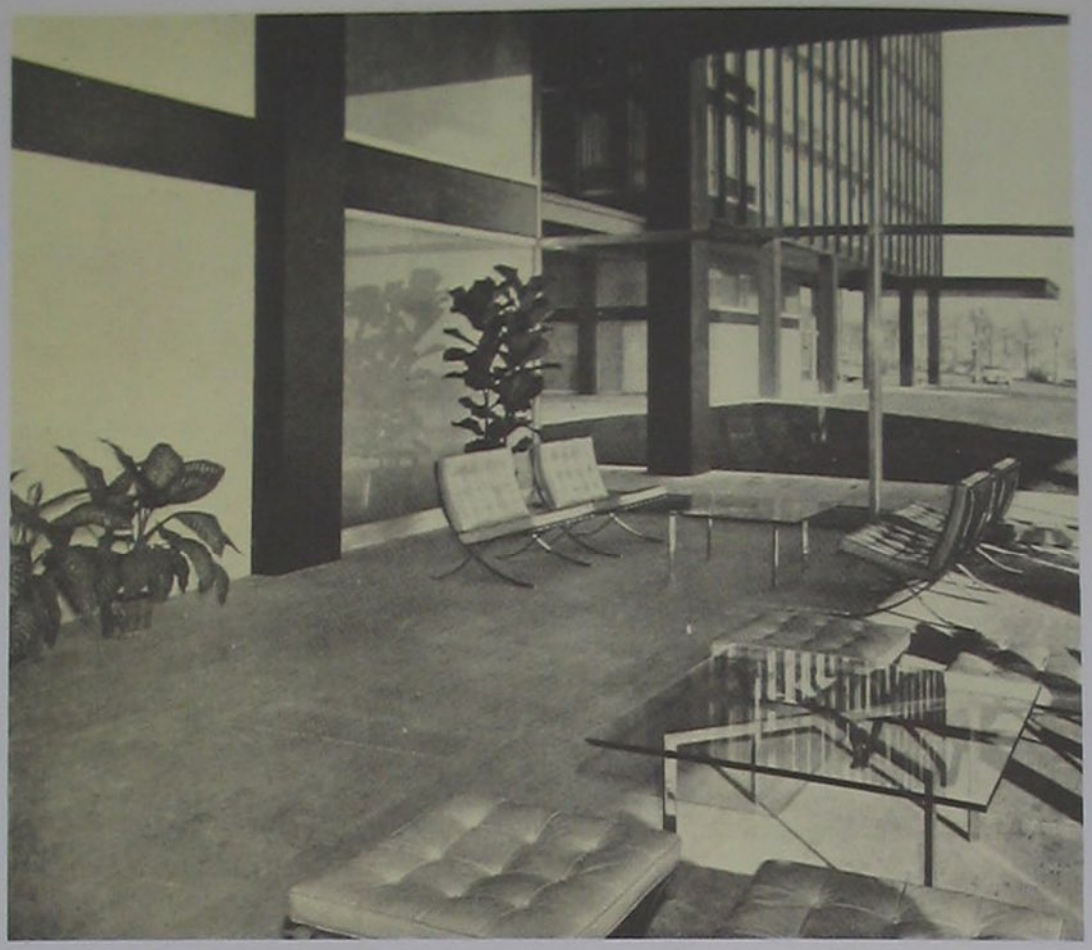


Bats navigate at night by emitting high-pitched squeaks and then picking up the echoes with their enormous ears. The squeaks are inaudible to most humans.

Bauhaus was an influential school of modern art and architecture that was founded in Germany in 1919. Its original director was the architect Walter Gropius, and among its outstanding members were the painters Paul Klee and Vasily Kandinsky, and the architect Ludwig Mies van der Rohe.

The Bauhaus group believed in functional design—the idea that beauty and usefulness should go hand in hand. They created buildings, furniture, household utensils and woven materials that were simple, attractive and at the same time well-suited to their purposes. They taught that even mass-produced objects could be well designed.

The Bauhaus was located in Weimar until 1925 when it moved to a new building designed by Gropius in Dessau. In



The entrance to an apartment block in Chicago, designed by Mies van der Rohe. Like the other members of the Bauhaus group he believed in combining beauty, simplicity, and usefulness. The chairs in the picture, known as 'Barcelona' chairs, are among the best known of all the Bauhaus designs.

1933, the Nazi government closed the Bauhaus down. There is now a Bauhaus museum in West Berlin.

Bears are big, *carnivorous* (flesh-eating) mammals with shaggy fur. They are closely related to dogs, but are much larger and have no tail. Big bears may grow up to 10 feet in length. They have thick, powerful legs and strong claws. In spite of their size, bears are nimble creatures, climbing quickly up trees and over boulders. Except for the polar bear, they are mainly forest animals.

In many stories, bears are shown as friendly animals, and they are popular for their tricks—such as standing on their hind legs—in captivity. But they are dangerous animals. In the wild, they may attack, kill, and eat a man without warning. Their normal food consists of small animals of all kinds, fish, birds' eggs, and even farm animals. But they also eat fruit, berries, roots, and other plant foods. They are very fond of honey.

Most bears live in the northern hemisphere. The black bear of North America is among the most numerous. It reaches a weight of about 300 lb, and, in spite of its name, may be brown. The Asian black bear is a quite different species that lives in the Himalayas, China and Japan. It has a white V-shaped marking on the chest.

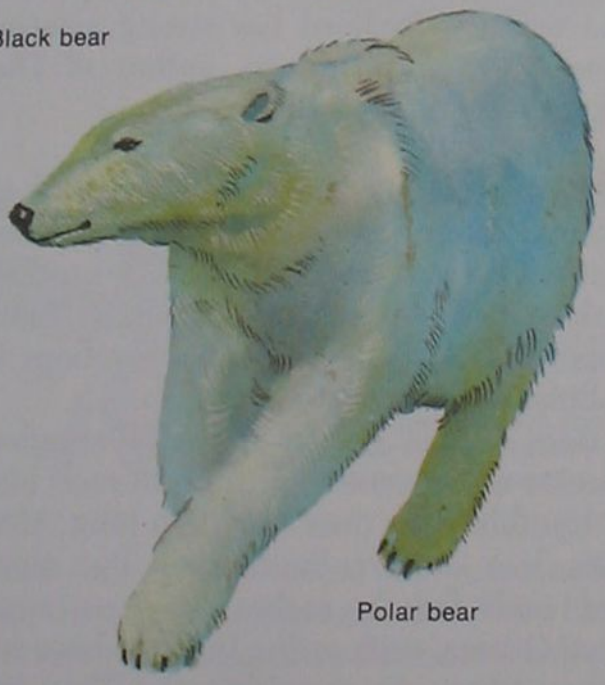
The brown bear of Europe and northern Asia—and the almost identical grizzly bear of North America—is much bigger than the black bear, weighing up to 1,500 lb. In spite of this size, brown bears are extremely quick and swim well. They are very powerful and are probably the most dangerous of all bears.

Polar bears are perhaps the best known bears. They live on Arctic iceflows, where their yellowish-white fur gives them good

Polar bears are very agile, despite their huge size. They can run at about 25 miles an hour, which is fast enough to catch reindeer. They are also the best swimmers of the bear family, and have been found as much as a hundred miles out to sea from the nearest ice flow.

Brown bear

Black bear



Polar bear

Grizzly bear

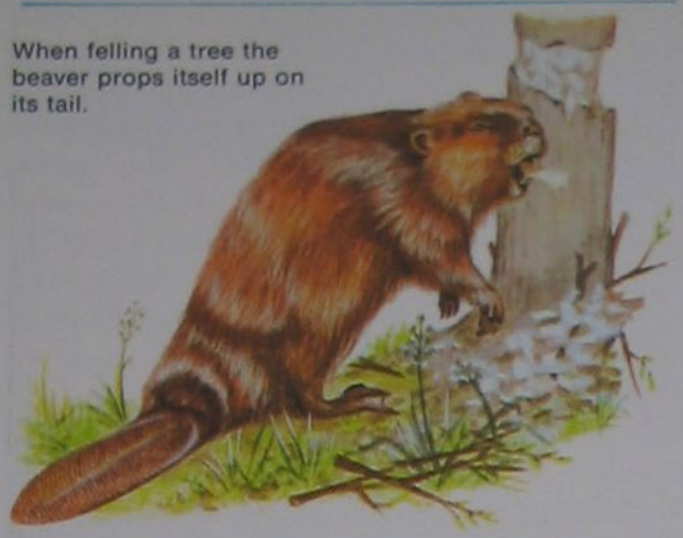
camouflage. Their main food is seal meat, but they also eat some fish, birds, and birds' eggs. They roam constantly, looking for food, but the female may spend the winter in a den under the snow, where the young are born. Fully grown polar bears weigh up to about 1,600 lb.

Other bears include the spectacled bear of South America, the sun bear of Asia, and the long-nosed sloth bear of India.

Beaver Many animals perform elaborate building tasks, constructing somewhere to rear their young, hide from enemies, and store food. But none constructs on the same scale as the beaver. These mammals —some 3 feet long and weighing about 40 lb—build dams up to 100 yards long and 12 feet high. They fell trees several feet in circumference, using their large front teeth to gnaw through the trunk. They dig canals 300 yards long, along which they float logs and branches. And they construct elaborate 'air-conditioned' homes—called *lodges*—with underwater entrances. A family group occupies each lodge.

The dome-shaped lodge is built in a stream or pond using branches held together with mud. The 'floor' of the lodge is just above water level but the entrances to it are always below water. Air enters through gaps in the walls and roof. The purpose of the dam-building is to keep a constant water level in the pond or river —and in the entrance to the lodge. Using this entrance, the beavers can leave the lodge even in the coldest weather and swim away underwater.

This is important, because beavers live in cold regions near the Arctic. They inhabit most northern parts of the United States and Canada. A few also live in northern Europe. The creature's streamlined body is well suited to fast underwater swimming. It uses its broad, flat, scaly tail as a rudder and an oar. It propels itself along with its webbed hind feet. It is also well suited to cold conditions,



When felling a tree the beaver props itself up on its tail.

with thick, double-layered fur. In spite of its watery surroundings, the beaver does not eat fish. It feeds on the bark of trees, and on leaves, shoots and roots.

Becket, Thomas à (1118-1170), was an English churchman who was *martyred* (put to death for his beliefs). He was originally a friend of King Henry II, and was appointed chancellor in 1155. Seven years later he became Archbishop of Canterbury. But the king began increasingly to try to govern the Church, and in his attempts to defend what he believed to be the Church's rights, Becket quarrelled with the king. He was forced to flee to France.

Shortly after his return to England, he was attacked by four knights in Canterbury Cathedral and murdered. Thomas a Becket was *canonized* (declared a saint) in 1172.

Becquerel, Henri (1852-1908), was a French physicist who, in 1896, discovered radioactivity. For this discovery he was awarded the Nobel prize in physics in 1903 along with Pierre and Marie Curie.

Becquerel made his great discovery quite by accident when he noticed that some well-wrapped photographic plates were affected by samples of uranium salts stored nearby. At first he thought this might be caused by X-rays, but soon realized that the change was caused by rays of a different kind. 'Becquerel rays' became an early name for radioactivity.

Bedfordshire, a county in the southern midlands of England, lies mainly in the basin of the River Great Ouse. Its county town is Bedford, and its area is 473 square miles.

Bedfordshire, one of the smallest counties in England, is largely agricultural. The land is mainly flat, except for Dunstable Downs, a spur of the Chiltern Hills, that rise in the southern part of the county. Important industries, including engineering and the manufacture of cars and textiles, are found in Luton (the largest town), Dunstable and Leighton Buzzard.

There are many signs in the county of early British and Roman occupation. The town of Bedford has strong associations with John Bunyan, author of *The Pilgrim's Progress*.

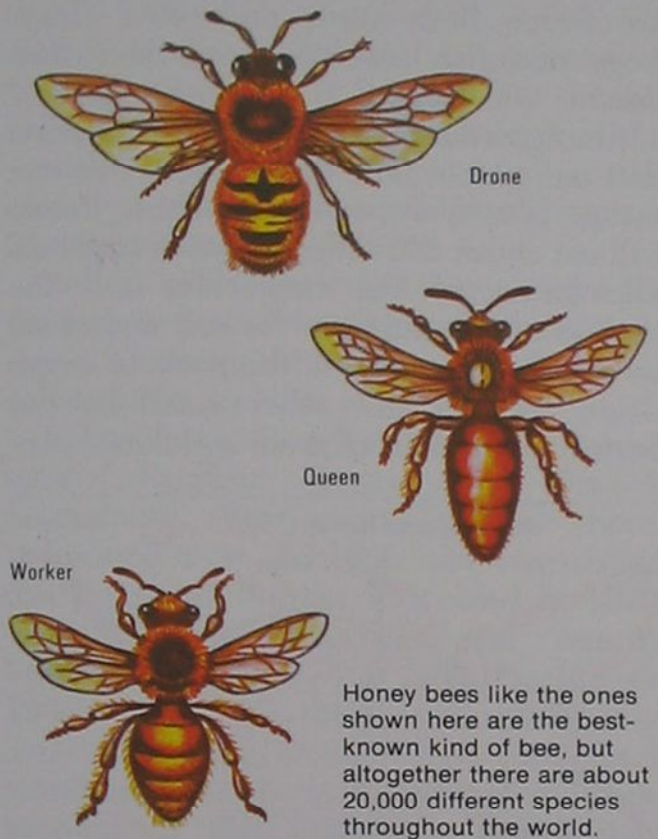
Bees are among the most useful of all insects. Honey bees produce the honey that we eat and beeswax which is used for making polishes and candles. Far more important is the part played by bees in pollinating our crops.

Bees vary in size from a small stingless species about one-twelfth of an inch long to bumble bees over one inch long. Most bees live *solitary* lives—they live alone and each female makes her own small nest. Others, such as the bumble bees and honey bees, are *social* insects. They live and work in large family groups.

Farmers care for honey bees by providing hives to house their colonies. There are three kinds of bees in a colony: *queens*, *workers* and *drones*. The queen bee heads the colony. She starts life like any other bee—as an egg laid in a cell in the honeycomb. But queens get special food when they hatch as larvae. After a few days, the larva is sealed in its cell; it changes into a pupa and develops into an adult. Sixteen days after the egg is laid, the young queen bites her way out of the

cell. She kills any rival queens and mates with one of the drones on a 'marriage flight'. She usually returns to the hive and ousts the old queen, who leaves in a swarm, accompanied by her workers, to start a new colony.

The queen bee's only function is to lay eggs in the cells of the honeycomb. Worker bees hatch from most of the eggs.



Honey bees like the ones shown here are the best-known kind of bee, but altogether there are about 20,000 different species throughout the world.

These are female bees that are smaller than the queen and never mate. They have the task of looking after the entire colony. They build the honeycomb, with its six-sided cells, out of wax produced by their bodies. The workers collect nectar and pollen from flowers. They fly about collecting food here and there, and then fly straight back to the hive in a *bee-line*. These bees show others where food can be found by performing a special dance that indicates the direction of the food in relation to the Sun. The workers then convert the nectar into honey and place it in cells. The workers also defend the colony, but they sting human beings only if they are frightened or hurt.

Male bees, called drones, appear mainly in the late summer. They do no work and have no sting. Their only job is to mate with the young queens on the marriage flight. Drones do not live very long.

Talking points

* What products of bees have been useful to Man?
* Honey bees are known as social insects. Explain why, and describe how hive life is organized.
* Bees play a vital part in plant life. What is this?

Articles to read

Ants; Insects; Flowering plants; Pollination.

Beethoven, Ludwig van (1770-1827), one of the greatest German composers, was born in Bonn. His greatness lies in the huge scope of his musical expressiveness and in his great technical inventiveness.

Ludwig's father was a singer. He hoped that his son might turn out to be a prodigy like Mozart, and earn him a fortune by performing on the piano. The father's tuition was rough and ready, and was given in more or less sober periods between bouts of heavy drinking. Ludwig made a great name as a brilliant young musician, but never rivalled Mozart's reputation as a 'wonder child'. By 1792, Ludwig had moved to Vienna, which became his home for life. Here his reputation as a pianist grew, until his ever-increasing deafness put an end to concert work.

About this time, he studied with Haydn for a brief period. The older man's influence can be heard in the early Beethoven symphonies. But in the later ones, culminating in the ninth and last—the *Choral*—he enlarges the scope of the

Beethoven at the age of about fifty. He began to grow deaf before he was thirty and became totally deaf in later life. Although there are few worse afflictions for a musician, he continued to compose and conduct his works, even though he was unable to hear a note.

symphony into something quite new. The middle and late period symphonies have a breadth of feeling and a richness of expression that is not found elsewhere in symphonic music. The orchestra for which he wrote these works was larger and had a greater variety of instruments than had been used before.

It was not only in the symphony that Beethoven added a new dimension to music. His piano sonatas explored the form and the instrument in a fresh and marvellous way. Again he seems to draw his inspiration from the depths of human feeling; equally effective in his sorrow as in his joy. This can be heard in his wistful *Adieux* sonata and his splendid *Appassionata* sonata. His technical accomplishments were no less impressive. His use of harmony was both individual and daring.

Chamber ensembles—trios, quartets, and so on—drew from him some of his most profound music. The late quartets—for two violins, viola, and cello—were very advanced music for his day, and many musicians today find that a lifetime is hardly enough to come to a full appreciation of these works.

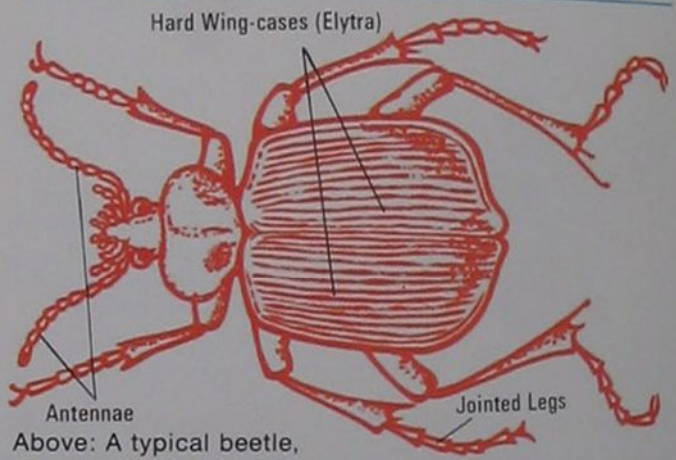
Beetles make up one of the largest groups of insects, the order *Coleoptera*. There are about a quarter of a million different species of beetles, varying in size from the Goliath beetle of Africa, which is four inches long, down to tiny beetles one-fiftieth of an inch in length. Beetles come in all shapes and sizes and feed on almost anything they can get between their strong jaws.

All beetles have a pair of hard wings, called *elytra*, which often have beautiful and colourful patterns. The elytra usually cover a second pair of thin wings actually used for flying. When a beetle flies, it raises its elytra out of the way of the flying wings. The heads of beetles have antennae, or feelers. The jaws are often small, but the large antler-like jaws of stag beetles are fearsome in appearance.

Beetles hatch from eggs as small larvae with biting mouthparts. They pass through an inactive pupal stage before emerging as adults.

Many beetles live in water. The diving beetles spend much of their time under water, getting their oxygen supply from an air bubble they trap beneath the elytra. They have to surface from time to time to renew the air bubble. Some diving beetles are fierce flesh-eaters and often attack frogs and fish several times their own size.

Among other beetles are several pests that eat plants. The Colorado beetle can ravage potato crops. The Japanese beetle will eat about 250 different kinds of plants. The larvae of the cockchafer and the click beetles tunnel in the soil and cause tremendous damage to the roots of crops. Grain weevils and other small beetles destroy many tons of grain and flour every



Above: A typical beetle, showing the hard wing cases (elytra).
Right: The Death Watch beetle.
Below: The Ladybird is a beetle. It is shown here attacking the fluted scale insect, a fruit tree pest.

year. The furniture beetle, or woodworm, attacks our homes.

However, some beetles are useful to man. Flesh-eating, or *carnivorous*, beetles eat other insect pests. The brightly coloured ladybirds serve man well by eating large numbers of greenfly. Dung beetles and burying beetles keep the countryside clean by burying and eating dung and dead animals.

Belfast is the capital and largest city of Northern Ireland. It has 385,900 inhabitants. It is located on Belfast Lough at the mouth of the River Lagan, and is the country's chief seaport. Shipbuilding is a leading industry.

Belfast is the manufacturing centre for the famous Irish linen. Aircraft, machinery, ropes, clothing, whiskey, processed foods and tobacco are also made there.

Belfast was founded in 1177. Later, many English, Scots and French Huguenots (Protestants) settled there. It became a city in 1888, and was named the capital of Northern Ireland in 1920. The parliament building at nearby Stormont was erected in 1932. During the 1960's and 1970's there were many riots and other disturbances in the city as a result of hostility and mistrust between sections of the Protestant and Roman Catholic communities.

Belfast has museums and art galleries. Its university, the Queen's University, was founded in 1845.

Belgium is a small, crowded country in western Europe. It is bounded on the west by the North Sea, on the north by The Netherlands, on the east by Germany and Luxembourg, and on the south by France.

About two-thirds of the country is a low-lying, fertile plain, through which the River Scheldt (Schelde) and its tributaries flow to the sea at Antwerp, the chief port. Brussels, the capital, lies in this plain.

In the south-east lies a highland area,

A view of Ghent. This historic Belgian city is sited at the junction of two rivers, and has over 200 bridges. In the Middle Ages Ghent was the centre of the Flemish cloth trade.

Map showing the location of Belgium (marked in black) in Europe.

Facts and Figures
Area: 11,779 square miles.
Population: 9,700,000.
Capital: Brussels.

Bruges has long been famous for the domestic manufacture of lace and embroidery. Here, lace-makers are shown at work.

the Ardennes. It is covered with forests or moors where sheep graze. The climate of Belgium is mild.

The people of northern Belgium speak Flemish, a language like Dutch. In southern Belgium the people speak French and Walloon, a language rather like French.

Farms cover nearly two-thirds of Belgium. They produce cereals, sugar-beet, potatoes and flax. Farmers also rear cattle, pigs and horses. Manufacturing is Belgium's main source of wealth. Factories turn flax into linen, and wool from the sheep into cloth. Other industries include manufacture of chemicals, and mining of coal and metal ores.

Belgium is a constitutional monarchy. It has a king, and the people elect the senate and house of representatives.

Until the 1800's, Belgium formed part of the Low Countries, an area that included what is now The Netherlands. Spaniards, Austrians, French and Dutch in turn ruled Belgium, but in 1830, Belgium finally won its independence.

In 1914, during World War I, the Germans invaded Belgium in order to attack France. Belgium was again occupied by the Germans in 1940, during World War II. It was liberated in 1944.

In 1957, Belgium joined with five other European countries to form the European Common Market, an economic alliance to make trading easier.

Belgrade, the capital and largest city of Yugoslavia, is situated on the banks of the Danube, where the River Sava meets it. Belgrade is an important centre for trade and transport, having river, rail, road and air links with the major cities of central Europe and the Balkans. It houses the parliament building, a university, many parks, museums and churches. Large factories produce electrical equipment, machines, textiles, chemicals and food products. The city's population is approximately 800,000.

Belgrade was first built as a Celtic fortress. The Romans established a colony there, and afterwards the city changed hands many times. It was the capital of the kingdom of Serbia before Yugoslavia was created. During World War II Belgrade was occupied by the Germans and partially destroyed. It was rebuilt after the war.

Bell, Alexander Graham (1847-1922), was a Scottish-born scientist who invented the telephone. Other inventors had tried to send speech by wire, but Bell was the first to succeed.

Bell's upbringing had a great influence on his career. His father was a successful teacher of deaf-mutes and had invented a code of symbols called Visible Speech to help them learn. Bell aided his father in his work, and also taught speech and music as a student teacher at a boys' school in Edinburgh.

In 1870 Bell moved with his family to Ontario, Canada, as he was suffering from tuberculosis from which both his brothers had died. He soon recovered, and went to Boston, Massachusetts, where he set up a school for teachers of the deaf.

Bell was made a professor at Boston University, but he still continued with his electrical experiments. He found doing all the work by himself rather difficult, so he enlisted help from a skilled electrician called Thomas Watson.

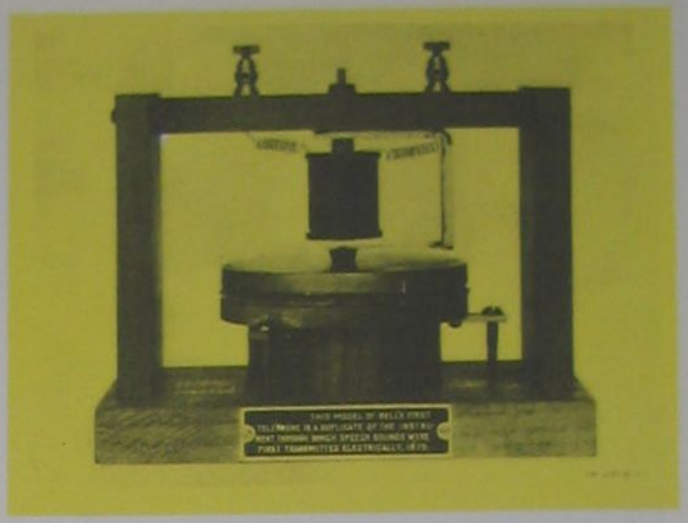
Together they proceeded with the experiments. Bell connected up a *transmitter*, a device which converted sound waves into electrical waves, to a *receiver*, which picked up electrical signals and converted them back to sound. They finally achieved success in 1875, when Bell heard a sound made by Watson coming through the receiver. The first spoken sentences were heard the following year when Bell spoke into the transmitter and was heard by Watson in a separate room. The Bell Telephone Company was founded in 1877, the first of its kind.

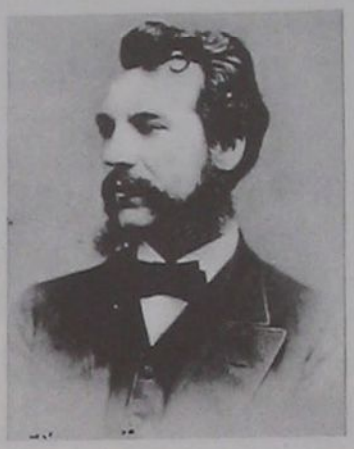
Bell continued to experiment and invent. He helped develop the first gramo-

phone record, and financed flying experiments. The promotion of teaching the deaf to speak was still one of his chief concerns. He became an American citizen in 1882, and died in Novia Scotia.

Bellbird is a name given to several different kinds of bird in different parts of the world, all of whose voices can be compared with the note of a bell. The white bellbird of South America sings one repeated note which carries over a mile. Two members of the honeysucker family in New Zealand are known as bellbirds, and the Australian bell miners are sometimes known as bellbirds too.

Bells come in many sizes for many uses. Some large bells are famous, such as Big Ben in the clock tower of the Houses of Parliament in London, the Liberty Bell in State House, Philadelphia, and the largest in the world, the Kolokol in Moscow, which weighs 193 tons. Church bells summon people to services. Teams of





Above: It was an instrument like this that Thomas Watson made for Bell overnight in June 1875. When the transcontinental line to San Francisco was opened in 1915. Bell talked to Watson over a replica of this instrument.

Left: Bell in 1876, the year in which the telephone was patented.

Below: Bell's telephone in operation.

Some bells, like this one in Venice, are more decorative than practical. The figures strike the bell with hammers.

ringers meet to ring *changes* on church bells. The teams ring the bells in various sequences, an art called *campanology*. Changes can also be rung on hand bells, and tunes can be played on them. The 'bells' in symphony orchestras are in fact metal tubes struck by mallets.

Bering Sea is an arm of the north Pacific Ocean that separates Alaska and Siberia. It extends from the Aleutian Island chain in the south to the Bering Strait in the north, where Asia and North America are only 53 miles apart. North of the Bering Strait lies the Arctic Ocean.

The Bering Sea is approximately 1,200 miles wide from east to west and 950 miles long from north to south. Severe ice prevents navigation from November to May.

In the Bering Sea lie the Pribilof Islands and several others belonging to the United States and the Komandorski Islands belonging to the U.S.S.R. The region around these islands was once very rich in fur-bearing seals and sea otters. Indiscriminate hunting of these animals almost caused their extinction and led to a dispute between the U.S. and Great Britain in the 1880's over the practice of pelagic sealing (catching seals in open sea). In 1911 an international agreement was finally reached protecting the seals.

The Bering Sea and Strait are named after Vitus Bering, a Danish navigator who explored the region for Russia in 1728 and 1741.

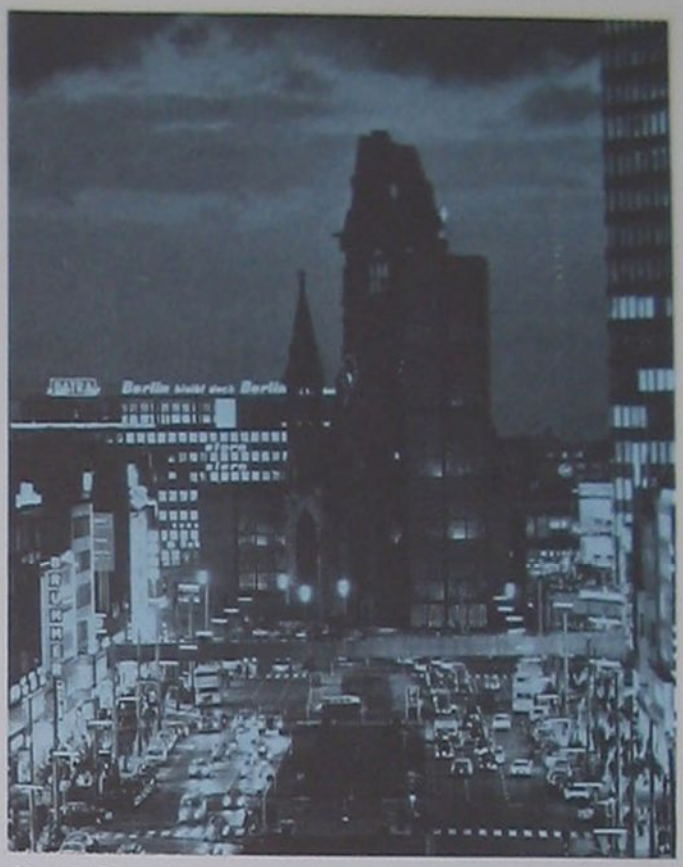
Berkshire, an inland county of central southern England, lies to the west of London. Its northern boundary follows the River Thames for about 100 miles. Its county town is Reading, and its area is 725 square miles.

The county is crossed from east to west by the Berkshire Downs, a line of chalk hills. The highest point is Inkpen Beacon, which rises to 975 feet in the south-west. Berkshire is mainly agricultural, with fruit growing and animal rearing as the main occupations. Reading is the only large industrial centre. It is also a university town. Other towns are Maidenhead, Windsor, Abingdon and Newbury. The royal residence of Windsor Castle is in Berkshire.

Berlin, presently consisting of the two parts, West Berlin and East Berlin, is the largest city in Germany. It is also one of the largest cities on the Continent with a population of 3,217,019. It lies

in the flat valley of the River Spree, which crosses the city from south-east to north-west. The city is encircled by pine forests and large areas of marsh and lakeland. Numerous canals connect it with the Oder and the Elbe rivers. Berlin is a commercial centre with large industries in electrical engineering, machinery and metal manufacture, chemical products, textiles, paper, foodstuffs and beer. Up to 1945 Berlin was the capital city, and, centrally situated, a focal point in European communications. Both functions were disrupted by division of Germany following World War II.

Much restoration work has been carried out since the war, particularly in West Berlin. Fine new roads have been built and many new structures rise to join the old buildings that survived.



Above: From the war ruins a prosperous, modern Berlin has risen.

Bermuda is a group of British islands in the North Atlantic Ocean. They cover an area of 21 square miles and have a population of 51,000. There are about 300 islands but only about 20 are in-

Below: The old State House in Saint George, Bermuda. This town was named after Sir George Somers, captain of the ship which brought the first permanent white settlers to Bermuda.

Location map showing the position of Bermuda.

habited. Hamilton, the capital, is on the largest island, which is also called Bermuda. Beautiful coral beaches, excellent swimming and a mild climate attract thousands of visitors. The scenery is magnificent. Attractive whitewashed houses are a feature of the islands. Cut flowers and perfumes are exported.

This island group has been ruled by Britain since the 1600's. Today it has a governor appointed by the British monarch. The governor is advised by the Executive Council, which is made up of members of the legislature.

Berwickshire, a county of south-eastern Scotland, lies between the Lammermuir Hills in the north-west and the River Tweed, which forms part of the border with England, in the south. Its county town is Duns, its area 457 square miles.

The chief river is the Tweed, which flows into the North Sea. Three of its tributaries also run through the county. The three main regions of Berwickshire are Merse in the south, whose rich lowland plains are ideal for growing cereals; Lammermuir, on the slopes of whose 1000-foot hills sheep are reared; and Lauderdale in the south-west

Two-thirds of the county are under cultivation. The manufacture of woollen textiles is a major industry, and fishing off the rugged coast is also important.

Bhutan is an independent mountainous state in the eastern Himalayas. It is bordered by Tibet to the north and India to the south. Bhutan is a rugged country covering about 18,000 square miles. The climate is cold and snowy in the mountains. In the south, such animals as leopards and tigers roam through hot, humid forests. Bhutan has a population of about 800,000, most of whom are Buddhists. Most people are farmers and their most important crops include corn and rice.

Location map showing the position of Bhutan.

Bible The Bible is the holy book of the Christian Church. It contains two parts, the Old and New Testaments. In the Old Testament God makes a *covenant* (agreement) with his chosen people, the Jews. If they love and obey Him, He will protect them. In the New testament a new covenant is established through the life and death of Jesus Christ.

The Old Testament, of 39 books, contains most of the Jewish scriptures. There is also a number of additional books which are sometimes included in the Old Testament. They are often referred to as the Apocryphal Books. The first five books of the Old Testament are known as the

Some early English versions of the Bible contained strange translations. In the so-called 'Breeches Bible', published in 1560, Adam and Eve are said to have 'sewed fig tree leaves together and made themselves breeches'. And in the 'Bug Bible' of 1551 the line 'Thou shalt not be afraid for the terror by night' in Psalm 91 was translated 'Thou shalt not be afraid of any bugges [bogeys] by night'.

Cõment noe entra en larche. et la fẽme. ⁊
les filz. et les fẽmes de ces filz. auecques tou
tes les choses que dieu lui ꝯmanda selõ
la bible.

An illustration from a 14th-century French Bible, showing Noah's Ark. Until the development of printing all Bibles were copied by hand, and many were elaborately decorated. Here gold leaf has been used for the initial capital.

Pentateuch or the 'Law', because they contain among other things the laws which Moses gave to the Hebrew people. There follow a number of books in which the journeys and conquests of the early Hebrew tribes are recorded. These are known as the Historical Books. There are also 16 books which contain the teachings of the prophets. Another group—the Poetical Books—includes poems, notably the psalms, and collections of wise sayings such as the Book of Proverbs.

All the Old Testament books were written in Hebrew, the language of the Jewish people. The earliest complete Hebrew manuscript dates only from the 9th century A.D.

The New Testament was written in Greek. The earliest complete manuscripts date from the 4th century. The New Testament contains 27 books. The first four books are called Gospels, a Saxon word meaning 'Good News'. They describe the life and teaching of Jesus. The Acts of

the Apostles provides a short account of the early Christians. There are also 21 letters or Epistles, most of them by St. Paul. Finally there is a strange book of visions called the Revelation.

One of the first translations of the Bible was made into Latin in 405 A.D. by St. Jerome. This version was called the Vulgate. The whole Bible was first translated into English in the 1300's. This was the work of John Wycliffe. William Tyndale's translation of the New Testament in 1525 was the basis of the Authorized or King James Version of 1611. The Bible, or parts of it, has been translated into over 1,300 languages and dialects.

Talking points

* The Bible is sometimes described as a library of books. Why? What are the different types of book in this library?
* Describe the ways in which the Bible has affected art, literature and our everyday lives.
* Write a play based on one of the stories in the Bible, like Joseph and his brothers or Tobias and the Angel.

Articles to read

Abraham; Christianity; David; Judaism; Jerusalem; Jesus; Moses; St Paul.

Biennal plants are those that take two seasons to grow from seed, mature, flower, and die. They delay flowering until their second year. Biennals such as beets, carrots and turnips are dug up at the end of their first year's growth when their swollen roots are full, and are used as food.

Biochemistry is the study of the chemistry of living organisms. Every living organism, from single-cell plants and animals to man, is made up of chemical compounds. Biochemists study the chemicals that make up living organisms and how they interact. Biochemistry concerns chemistry and *physiology* (the study of living processes). It is sometimes called *chemical biology* or *chemical physiology*.

Biochemistry only developed in the 1900's, when scientists knew enough biology and chemistry to compare and combine them. More recently, biochemists have been studying *molecular biology*, that is, how the smallest particles of living organisms are constructed and arranged.

The plumage of Birds of Paradise is very beautiful. The illustration shows a male Red-Plumed Bird of Paradise. The plumes do not come from the tail but from just behind the wings.

Biology is the study of living things. It is divided into two main branches, *botany* (the study of plants) and *zoology* (the study of animals). These in turn have many subdivisions.

Bird of paradise This is the name given to a group of tropical birds from New Guinea and northern Australia. They are noted mainly for their dazzling feathers, which grow in many unusual forms. Birds of paradise live in thick forests, and eat fruits and insects.

During the mating season, the males gather in trees to show off their gorgeous feathers to the drab-looking females. The parade consists of dancing, strutting, and spreading their feathers. The females build the nests and lay from one to three spotted white eggs.

In the old days, many people used the beautiful feathers of the bird of paradise as decorations for their hats, and the birds were hunted until they almost died out. But today they are protected by law.

Birds are feathered animals. All birds have wings, although some of them cannot fly. The other main feature is the beak. This is made of horny layers built up around the jaw bones. It takes the place of teeth (no modern birds have teeth), and the bird also uses its beak like other

animals use their front legs—for finding food and for making homes.

Birds live in all parts of the world, hot and cold. They inhabit all situations, from mountains and deserts, through fields and woodlands, to marshes, lakes, and the open sea. There are about 8,600 different kinds of birds in the world and they are divided into many different groups. The largest group has several names—*perching birds, passerines,* or *song birds.* There are about 5,000 different kinds in this group—more than all the other groups put together. All the true singing birds belong here, the thrushes, robins, warblers, canaries, and so on. Most of them live in trees and their toes are suited to gripping the branches—hence the name of perching birds.

The rest of the birds are arranged in relatively small groups: the owls, the hawks, the game birds, the parrots, and so on. The large flightless birds, such as the ostriches and emus, are placed in their own groups and separated from all other birds. But not all flightless birds belong with the ostriches and their kind. Penguins are a separate group, while the dodo was a flightless member of the pigeon group. There are flightless members in many other bird families.

Scientists believe that birds have descended from reptiles and that their feathers have developed from scales. There is strong evidence for this belief in the scales that still remain on birds' legs. The oldest bird fossils so far discovered are at least 150 million years old, and show many connections with reptiles. In spite of their reptile ancestors, birds are warm-blooded, like human beings. They keep their bodies at a fixed high temperature whether the air is hot or cold.

The skeleton of a bird is well built for flight. The bones are small and thin, and therefore light, although they are strong. The long bones are hollow and are often given extra strength by criss-crossed 'struts' inside. More than half of a bird's weight is muscle, and the largest muscles are those that move the wings. These are very powerful muscles and must have good anchorage. This anchorage is provided by the breast-bone, which has a large, thin *keel* projecting from the underside, just like the keel of a yacht. The muscles are attached to this keel. Flightless birds have only a small keel, and some of them have no keel at all. A bird's wings are specially constructed front legs, and they bear the long sturdy feathers that are necessary for flight.

Most birds are very active animals, and they use up a lot of energy. In order to get this energy, they have to spend a great deal of time eating. Many birds, especially the seed-eaters, have a stretchable bag near the beginning of their food canal. This bag is called the *crop,* and quite a lot of swallowed food can be stored there. This is particularly useful for birds such as pheasants and pigeons that have many enemies and have to get as much food as they can when their enemies are not around. The food collected in the crop can be digested later.

Seed-eating birds and some others also have a very muscular region in the stomach that is called the *gizzard.* Seeds are ground up there, often with the aid of grit swallowed by the bird, before passing further down for digestion.

As well as plenty of food, birds need a good oxygen supply to meet their energy needs. Their lungs are specially built. When human beings breathe in and out, a lot of stale air remains in their lungs, and so they do not have a lung full of fresh air. Birds, however, have *air sacs* beyond the lungs. When they breathe in, the air rushes *through* the lungs and into the air sacs. When the birds breathe out

Most birds seldom fly higher than 3,000 feet, but migrating geese have been observed flying at more than 29,000 feet over the Himalayas. The longest migration flight is that of the Arctic tern. It leaves the Arctic in August and flies to the Antarctic, returning to the Arctic in June. The round trip is about 22,000 miles.

Some of the World's Birds

A few of the countless varieties of birds throughout the world are illustrated on these pages. Birds vary in size so greatly that no attempt has been made to approximate them to a scale. Instead, the *average* length of the bird is given from the tip of the beak to the tip of the tail.

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1. The Great Tit (left), the Varied Tit (centre) and the Blue Tit (right) are all about five inches long. They live in Europe and the East.

2. The Golden Pheasant. 36 inches long.

3. The Blackbird (left), the Song Thrush (centre), and the Nightingale (right) all have beautiful songs.

4. The American Oystercatcher. 18 inches long.

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5. There are some 300 different species of hummingbird, the smallest of which is two inches long.

6. The male Superb Lyrebird. 38 inches long including tail.

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7. The Crowned Crane (left), 38 inches long. It comes from Africa. The Sarus Crane (right) lives in India, Burma and Thailand. 60 inches long.

8. The Arctic Skua. 16 inches long.

9. The Red-throated Bee-eater. 9 inches long.

10. The Common Dipper. 7 inches long.

11. The White Stork. 40 inches long.

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12. The Common Puffin. 10 inches long.

13. The Lined Tiger Heron (left). 30 inches long. The Agami heron (right) is the same size.

14. The Chough is a member of the Crow family. 15 inches long.

15. The Bohemian Waxwing. 8 inches long.

16. The Winter Wren. 4 inches long.

17. The Hill Mynah, from India. 13 inches long.

18. The Common Nighthawk. 9 inches long.

19. Shrikes are between 7 and 10 inches long.

20. The House Sparrow. 6 inches long.

21. The Northern Gannet. 40 inches long.

22. The Hoopoe. 11 inches long.

23. The Great Hornbill is found from India to Sumatra. 60 inches long.

24. The Scarlet Ibis (above), 24 inches long. The Roseate Spoonbill (below), 30 inches long.

again, the air rushes back through the lungs. There is always fresh air in the lungs, and they can get plenty of oxygen from it. The sacs also help to buoy the bird up in the air.

A good pair of lungs is not much use without a good blood system to carry the oxygen round the body. Birds also have a good blood system, with a four-chambered heart giving an efficient circulation similar to that of human beings.

All birds reproduce by laying eggs, and they usually lay their eggs in spring or early summer. Egg-laying time is called the *breeding season.* Even in warm climates birds generally have a definite breeding season. The birds start by choosing their mates. Male birds often have bright colours and frequently use call songs that attract mates and may also warn other males away from the chosen territory. There is a good deal of courtship and display by one or both birds, and this eventually leads to nest-building and mating. Nests are mainly places to lay eggs and rear young: they are not permanent homes. Some birds do not even bother to make a proper nest. They use a hollow in the ground or a rocky ledge.

Some birds lay as many as 20 eggs, but half a dozen is more usual. Many birds of prey lay only one or two eggs. After being laid, the eggs have to be *incubated* (kept warm). The birds do this by sitting on their eggs. Sometimes only one parent will sit on the eggs, sometimes both parents take it in turns. The sitting bird is fed by its partner. The eggs generally hatch in two to three weeks, although some kinds of birds need longer.

Many ground-nesting and water-nesting birds already have feathers when they hatch. They can leave the nest right away, although they still have to be looked after by their mother. Ducks and chickens are examples. Tree-living birds, however, are generally very poorly developed when they hatch, completely naked and blind, and quite unable to move about. Young chicks are always very hungry, and their parents bring them a continuous supply of food. Nestling birds grow and develop very rapidly as a result of the endless feeding, and are ready for their first flying lesson after a few weeks.

Although young birds have the ability to fly right from the start, they have to learn to use their wings, and they often fall in the process. The mother encourages her offspring to fly by flying a short distance herself and then calling to the young ones. When once the young have mastered the art, the family breaks up and leaves the nest. Some birds pair for life and may return year after year to the same nest.

The length of a bird's life varies. Ravens have been kept for 70 years, and parrots for more than 60, but they probably have much shorter lives in the wild.

During the course of their *evolution* (development) most groups of birds have become accustomed to their own special nesting habits and particular methods of feeding.

Gulls, auks, and certain other groups have adopted a diet of salt water fish. Accordingly, they live around the coasts, nesting on rocky cliffs and flying out to sea to catch food.

Fresh water, both running and still, has a large bird population—ducks, moorhens, swans, herons, dippers, and many more—all finding a suitable diet in or around the water. Several groups have taken to living on moorland and other stretches of open country.

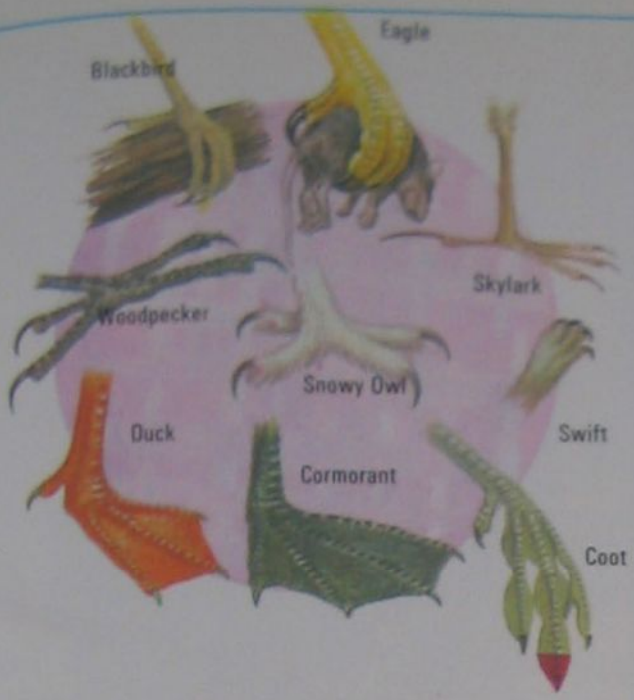
The many kinds of woodland birds—woodpeckers, parrots, nightjars, toucans, and so on—each have their own particular way of life, and their own food preferences.

Talking points

* Birds' beaks and claws have evolved to suit their ways of life. Give examples of this.
* Several species of birds are in danger of dying out. Name as many as you can, and give reasons.
* List as many birds as you can that live in your neighbourhood. Note some of their habits and their songs.

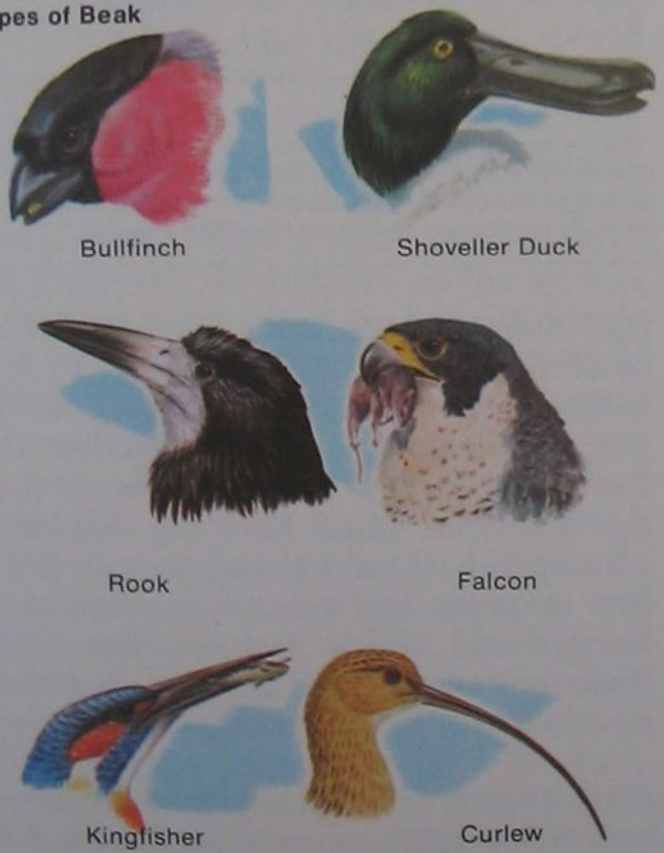
Articles to read

See under names and types of birds. Also: Feathers; Flight; Migration; Nails and claws.



A bird's feet vary with the type of life it leads. A glance at its feet and beak can give a good idea of the kind of bird it is. For example, swimming birds, such as ducks, have webbed feet, which they use as paddles in the water. Birds of prey, such as eagles, on the other hand, have powerful feet with sharp talons which they use for grasping and killing their prey.

Types of Beak



The Bullfinch has a stout beak for cracking seeds, while the Shoveller Duck uses its beak for straining mud and water. The Rook has an all-purpose beak, as it will eat almost anything. The Falcon's is hooked to kill and tear its prey. The Kingfisher has a dagger-like beak to catch fish and the Curlew a curved one for probing the mud.

Right: The Osprey or Fish Hawk.

Below: The Cinnamon Scops Owl.

Birds of prey are divided into two groups, the hawks and the owls. Both have hooked beaks and strong talons. The owls have both eyes looking forward. The hawks' eyes are on each side of the head. Owls usually hunt at night and hawks during the day.

Birds of prey are birds that feed on other animals, such as mammals, reptiles, and other birds. They all have powerful feet and *talons* (claws), and heavy, hooked beaks with which they kill and tear their prey.

The two main groups are the hawks (including eagles and harriers), which hunt mainly by day, and the owls, which hunt mainly by night. Hawks have an eye on each side of their heads. Owls have both eyes looking forward, which gives them a somewhat human appearance.

Other birds of prey include vultures, which feed on sick and dead animals, and the secretary bird, which kills snakes. The osprey, which eats fish, is also included in this group.

Birds of prey are found in all parts of the world. They range in size from some hawks that are no bigger than a starling, to gigantic eagles, and the majestic condor, with a 10½-foot wing span.

Birmingham, the second largest city in England, spreads into three counties. The city itself is in Warwickshire, but its suburbs stretch into Staffordshire and Worcestershire. The population of the city and its suburbs is more than 2½ million.

The history of the city goes back at least to the 11th century. With supplies of coal, iron and sand close by, Birming-

ham today is the most important manufacturing centre in Britain. It is also a city with a reputation for encouraging the arts.

Bismarck, Otto von (1815-1898), unified Germany and became the most powerful European leader of his time. Bismarck came from Prussia, one of the states in the loosely tied German Confederation that also included Austria. He became prime minister of Prussia under King William I, in 1862, and used this post to advantage.

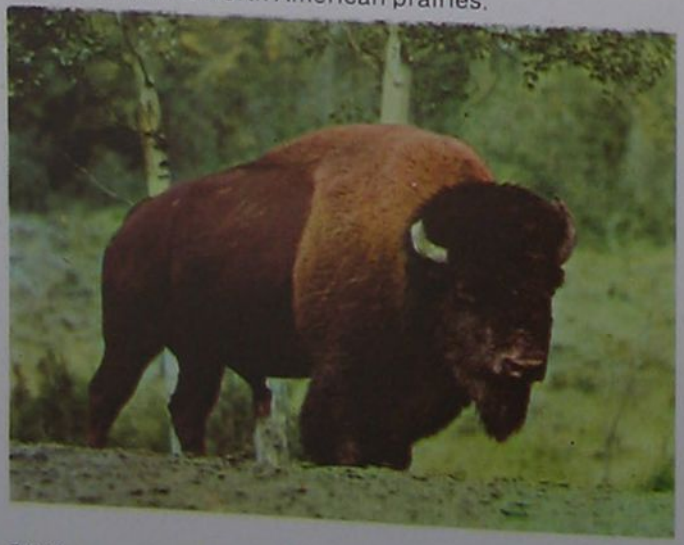
First, he won Schleswig-Holstein from Denmark in 1864. Then he turned against Austria, ousting her from the Confederation in the Seven Weeks' War of 1866. Finally, he won territory from France in the Franco-Prussian War of 1870-71. In 1871, when William I became ruler of a new German Empire, Bismarck was named imperial chancellor.

As chancellor, Bismarck drew up alliances with the important European nations and initiated reforms at home. His autocratic methods earned him the name of the 'Iron Chancellor'. He was forced to resign in 1890 by the new emperor, William II.

This famous cartoon, drawn by John Tenniel for *Punch*, shows the young emperor of Germany, William II, dismissing Otto von Bismarck who for many years had skilfully guided the developing German empire.

Bison are the large, horned wild oxen of North America and Europe. They are often called *buffalo*, but are quite different from the buffalo of Asia and Africa (see Buffalo). Male bison are bigger than most domestic cattle, reaching 10 feet in length and weighing up to 2,500 lb. But the females are much smaller. The European species is slightly longer than the American. Bison have big shoulders, a humped back, and a shaggy mane. They live in herds and once roamed most of Europe and North America. But many thousands were killed by man, and they now live only in zoos and game reserves.

A magnificent bison in Alberta. Vast herds of bison once lived on the North American prairies.



Black Death, or bubonic plague, has been known for 2,000 years. The disease has occurred chiefly in Asia, but Europe suffered epidemics in the sixth century and from the fourteenth to the seventeenth century. Plague starts among rats and is passed to man by fleas. Among the

Left: This picture from a medieval manuscript shows a procession of flagellants during an outbreak of the Black Death in Europe. The word flagellant comes from the Latin for whip. The flagellants were so-called because they whipped themselves to stop God's wrath, which they believed caused the Black Death.

signs of the disease are black swellings under the skin. A person catching it may die within three days. The nursery rhyme 'Ring-a-ring of roses' may describe the rosy rash, the posy of herbs for protection, the fatal sneezing and the final dying of plague victims.

The most famous outbreak in Europe was from 1347 to 1350. Plague spread along the trade routes from Asia. People had no idea what caused the disease. Some thought it came from disturbances among the planets; others believed it was a sign of God's anger. Magical signs, such as writing the word 'abracadabra' in the form of a triangle, were used to protect people from the disease. In Germany people called 'Flagellants' walked in procession through the streets whipping themselves to stop God's wrath. Sick people were forbidden to enter towns or buy food. Infected clothing was burnt, and the air was cleansed by burning juniper and sweet-smelling herbs. The dead were buried in big pits. A third of the people of Europe may have died. There was a great shortage of men to farm the land. Peasants were thus able to bargain with their lords for better conditions.

One of the last great epidemics occurred in London in 1665. Cleaner living conditions and the killing of rats have reduced outbreaks of the plague, which is rare today even in Asia.

Below: Burying the dead near London during the Great Plague

Black magic The 'art' of magic is an attempt to alter events in some secret, mysterious and unscientific way. Magic is now considered impossible and false, but earlier in history it was believed to be quite possible. *Black magic* was the name given to magic attempted for evil reasons. The opposite of black magic was the so-called *white magic*. This term was associated with endeavours undertaken for what might be deemed to be good or worthwhile reasons.

The *black magician* was supposed to be able to control evil demons, and force them to execute his commands. It was thought that such a person could even gain power over the Devil.

The methods used by those who called themselves magicians were kept secret, and the black magician guarded his *spells*

This strange painting by William Blake is called *Pity*. Like his poems, his paintings were filled with elaborate mythological symbols.

especially closely. The number of 'practising' magicians was always quite limited, and their written records were confined to special 'magic books' called *grimoires*.

Black Sea This is a large sea lying between southern Europe and Asia. It is bounded by Bulgaria, Rumania, Turkey and Russia. It covers about 170,000 square miles. The Danube, Dnieper, Don and many other rivers flow into it. The Black Sea is linked to the Mediterranean Sea by the Bosporus Strait, the Sea of Marmara and the Dardanelles Strait. In the north, the Kerch Strait connects the Black Sea to the 14,500-square-mile Sea of Azov.

The Black Sea has only one outlet—the Mediterranean.

The Black Sea possibly gets its name from the dark colour of the water when it is covered by thick fog. It is an important seaway and fishing region.

Blake, William (1757-1827), was an English poet and artist of great imagination and genius, who was also a revolutionary and fighter against injustice. He rejected many ideas that most people of his time accepted, and he supported the American and French revolutions. He was also deeply religious and claimed to have prophetic visions.

Blake was born in London and lived there most of his life. He began writing poetry at the age of 12, and became an engraver's apprentice at 14, later earning his living as an engraver. Blake produced many books of poems illustrated by means of *illuminated printing* (copper-plate etching coloured over in ink). His writings and paintings were a powerful portrayal of his beliefs. They were filled with mythological symbols and religious figures. Three of his best-known books are *Songs of Innocence* (1789), *Songs of Experience* (1794) and *Jerusalem* (1804).